REPORT RESUMES

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THE LIBRARY OF TOMORROW - TODAY, AND INFORMATION SERVICE OF EDUCATIONAL RESEARCH MATERIALS.
BY- KENT, ALLEN AND OTHERS
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THE PRELIMINARY PLANNING FOR THE DEVELOPMENT AND OPERATION OF AN INFORMATION RETRIEVAL SYSTEM IN THE FIELD OF EDUCATIONAL RESEARCH IS REPORTED. THIS PLAN WAS BUILT UPON DETAILED SUBJECT ANALYSIS AND RETRIEVAL OF DOCUMENTS BY A NATIONAL NETWORK TERMED THE EDUCATIONAL RESEARCH INFORMATION CENTER (ERIC). AN INVESTIGATION WAS ALSO MADE OF USE OF SELECTIVE DISSEMINATION OF INFORMATION. A DISCUSSION WAS INCLUDED OF A TEST ANALYSIS DONE ON APPROXIMATELY 4,000 DOCUMENTS. VARIOUS INPUT-OUTPUT CONFIGURATIONS WERE COMPARED. THE EXERCISING OF ADEQUATE BIBLIOGRAPHIC CONTROL OVER EDUCATIONAL RESEARCH INFORMATION IS ANTICIPATED BY MEANS OF THIS SYSTEM. (RS)

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THE LIBRARY OF TOMORROW--TODAY

An Information Service of Educational Research Materials

Cooperative Research Project No. 1298
Title VII Project B-170

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1962

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3414a

June 11, 1962

Office of Education
U. S. Department of Health,
Education, and Welfare
Washington 25, D. C.

Attn: Cooperative Research Branch
Educational Media Branch

Gentlemen:

We are pleased to transmit, herewith, 50 copies of our report on "An Information Service of Educational Research Materials," a program undertaken on April 3, 1961, as Cooperative Research Project No. 1298 and Title VII Project B-170. Upon notification of approval and acceptance, 200 additional copies will be sent to the Documents Expediting Project, Library of Congress.

In receiving this report, backed up by a file of 4,000 documents whose detailed indices are stored on magnetic tape, the U. S. Office of Education has pioneered by fostering the development of the first major mechanized information storage and retrieval system in a "soft" subject field. Until now the developments have centered in the "hard" sciences, which not only have been viewed by the public as more glamorous, but also where the subject matter is amenable to computer search with not too much pain, and where there is even hope that computer interpretation of source documents may be feasible at some time in the future.

But in educational research the matter is considerably different; it is probable that human analysis can never be replaced during the initial interpretation stage. However, once analyzed, the educational research field can benefit as much if not more than the "hard" sciences by computer search and correlation of the literature.

As may be evident from these comments, the past year's task has not been an easy one, nor can the development be considered to be completed. However, we are confident that the system is ready for beginning operations, as long as sufficient leeway is provided to permit adjustment of various aspects of the system based on the pressures of operations--however limited at first.

This leads also to our conclusion and recommendation that a continuing budget be allocated to cover the continuing research and development acitivity that must parallel the operating information service.

Although the enclosed report is signed by members of Western Reserve University's Center for Documentation and Communication Research, I wish to acknowledge gratefully that others have contributed substantially to our thinking, and have advised and aided us on one or more portions of the work, in particular:

1. Western Reserve University, Department of Education
2. American Education Research Association, Advisory Committee
3. Staff members of the U. S. Office of Education

We look forward with interest to the future, gratified in having had a most challenging assignment, and standing ready to work toward the creation of the operational version of ERIC--the Educational Research Information Center.

Very truly yours,

Allen Kent

Allen Kent
Principal Investigator

AK/ag

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CHAPTER ONE

INFORMATION RETRIEVAL: THE BACKGROUND

The dimensions of the problem of exploiting recorded knowledge have been changing. A century ago it was considered routine for the doctoral candidate to read the entire previous literature in his field; then, reading the current literature would require only a small fraction of his time. Today, the rapidly expanding research facilities of our nation have been pouring forth a cascade of new knowledge so great that even devoting all of one's waking hours to reading would not make it possible for the student, the educator, the researcher, or the practitioner in any field to keep up with all the reports of interest or pertinence to their work which are appearing in the literature.

The library, which has traditionally served as one of the memory functions of our civilization, has been hard pressed by the mounting literature, and has acquired an ally, the "information center," whose functions are related to those of the library except that it undertakes to serve requirements of a more specialized nature than those the library has normally been expected to meet.

But who are the persons and what are the purposes the information center should serve?

First, let us look at the various fields of scholarship which are becoming increasingly complex and interdisciplinary. Each field impinges upon and draws heavily from other fields, and, to some degree, on every other field of human endeavor. These subjects, as well as the "core" of a particular field, are being constantly augmented by new knowledge resulting from the theoretical, experimental, and clinical investigations that are going forward at all times.

In the wide range of subjects that encompass each area of scholarship, the body of knowledge already available must be fully utilized to assure that research is fully productive, that teaching is based on the most modern knowledge, and that practice employs the most modern advances. Superimposed on this need is the need of management, whether in education, research, government, or foundations, for insight into the performance of those they are supporting, as measured against what has been published by others.

To generalize, the need is for access to recorded knowledge that will provide rapidly, conveniently, economically, and precisely, that portion of the literature that will be useful:

-- to any individual

-- at any particular time

-- for any particular problem

-- and in any form that is useful to him,

regardless of:

-- where and when it was produced

-- in what form or language it exists

-- how it must be located and processed.

The ideal would be to have information available on the day of publication, accurately translated into the user's native tongue, and packaged in quanta that are infinitely variable in size and point of view.

Now what stands in the way of realizing this utopian dream?

1. No one individual, no one organization, no one agency, no one country can identify or acquire with absolute certainty all of the articles, papers, reports, and other communication media that contain useful information.
2. No one individual can read, much less retain in his memory, all of the recorded knowledge that might be of current or future interest.
3. The traditional library tools have become progressively less effective as the volume of material grows and the requirements of individuals become more specialized.

The dilemma of the reader is presented in some detail in Figure 1.1.

Traditionally, specialization has been the individual's defense against this exponential growth in recorded knowledge, for it has been only through specialization that the individual has been able to reduce knowledge to manageable proportions. However, the various fields of scholarship are becoming increasingly interdisciplinary, and the specialist must now keep abreast of knowledge outside his narrow specialty if he is to work efficiently and communicate with his colleagues. Thus, in a sense, does specialization carry within itself the seeds of its own destruction.

The response, then, becomes the delegation of most of the tasks of literature review to others. But, the delegees are faced with their own technical problems in not being in close physical or intellectual contact with those whom they attempt to serve (see Figure 1.2). The result is a compromise by the scholar (see Figure 1.3)--a compromise that is not always satisfactory--between individual effort and delegation of tasks (see Figure 1.4).

Figure 1.1

THE READER'S DILEMMA

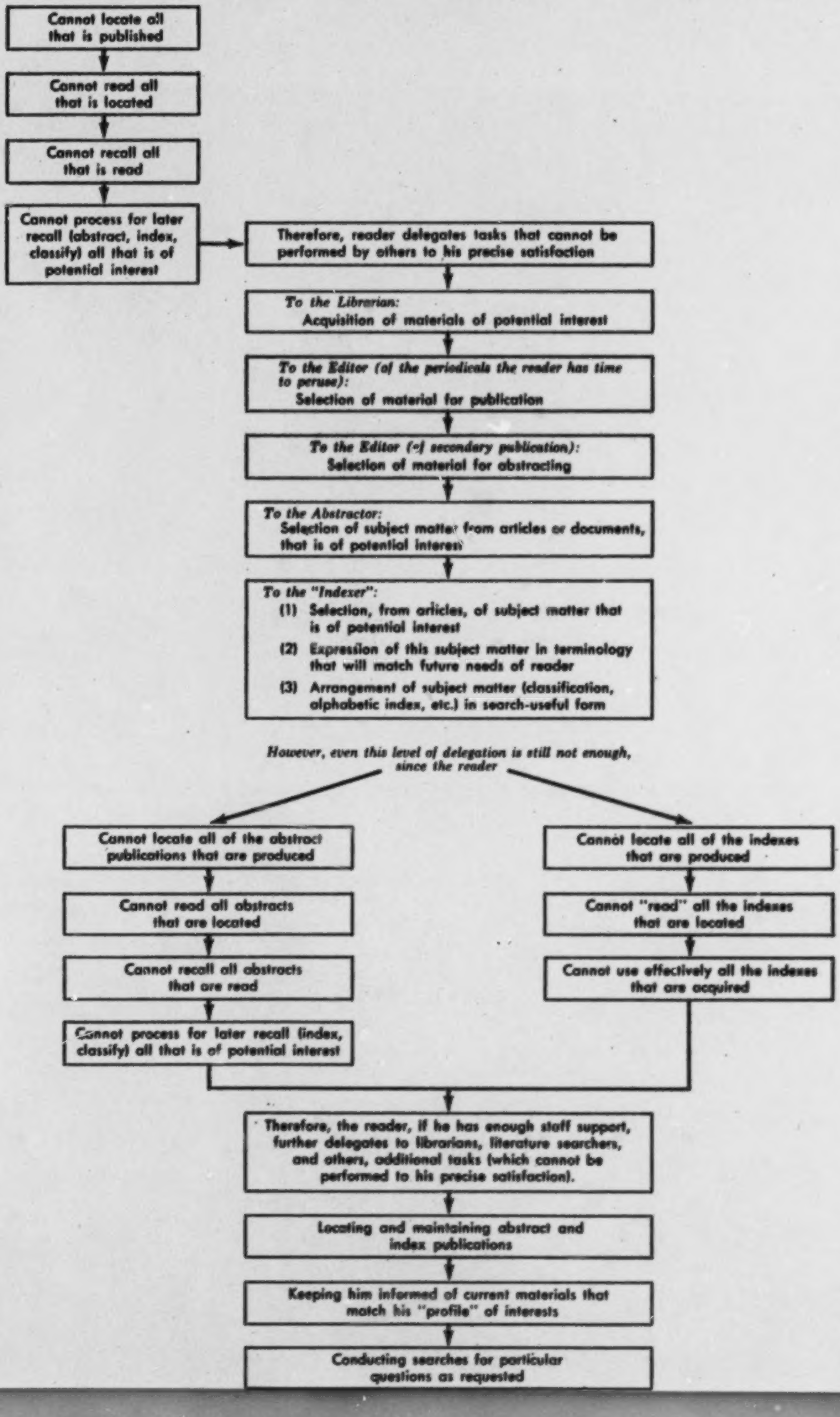

Cannot locate all that is published
Cannot read all that is located
Cannot recall all that is read
Cannot process for later recall (abstract, index, classify) all that is of potential interest
Therefore, reader delegates tasks that cannot be performed by others to his precise satisfaction
To the Librarian: Acquisition of materials of potential interest
To the Editor (of the periodicals the reader has time to peruse): Selection of material for publication
To the Editor (of secondary publication): Selection of material for abstracting
To the Abstractor: Selection of subject matter from articles or documents, that is of potential interest
To the "Indexer": (1) Selection, from articles, of subject matter that is of potential interest (2) Expression of this subject matter in terminology that will match future needs of reader (3) Arrangement of subject matter (classification, alphabetic index, etc.) in search-useful form
However, even this level of delegation is still not enough, since the reader
Cannot locate all of the abstract publications that are produced
Cannot read all abstracts that are located
Cannot recall all abstracts that are read
Cannot process for later recall (index, classify) all that is of potential interest
Cannot locate all of the indexes that are produced
Cannot "read" all the indexes that are located
Cannot use effectively all the indexes that are acquired
Therefore, the reader, if he has enough staff support, further delegates to librarians, literature searchers, and others, additional tasks (which cannot be performed to his precise satisfaction).
Locating and maintaining abstract and index publications
Keeping him informed of current materials that match his "profile" of interests
Conducting searches for particular questions as requested

Figure 1.2

THE "INDEXER'S" DILEMMA

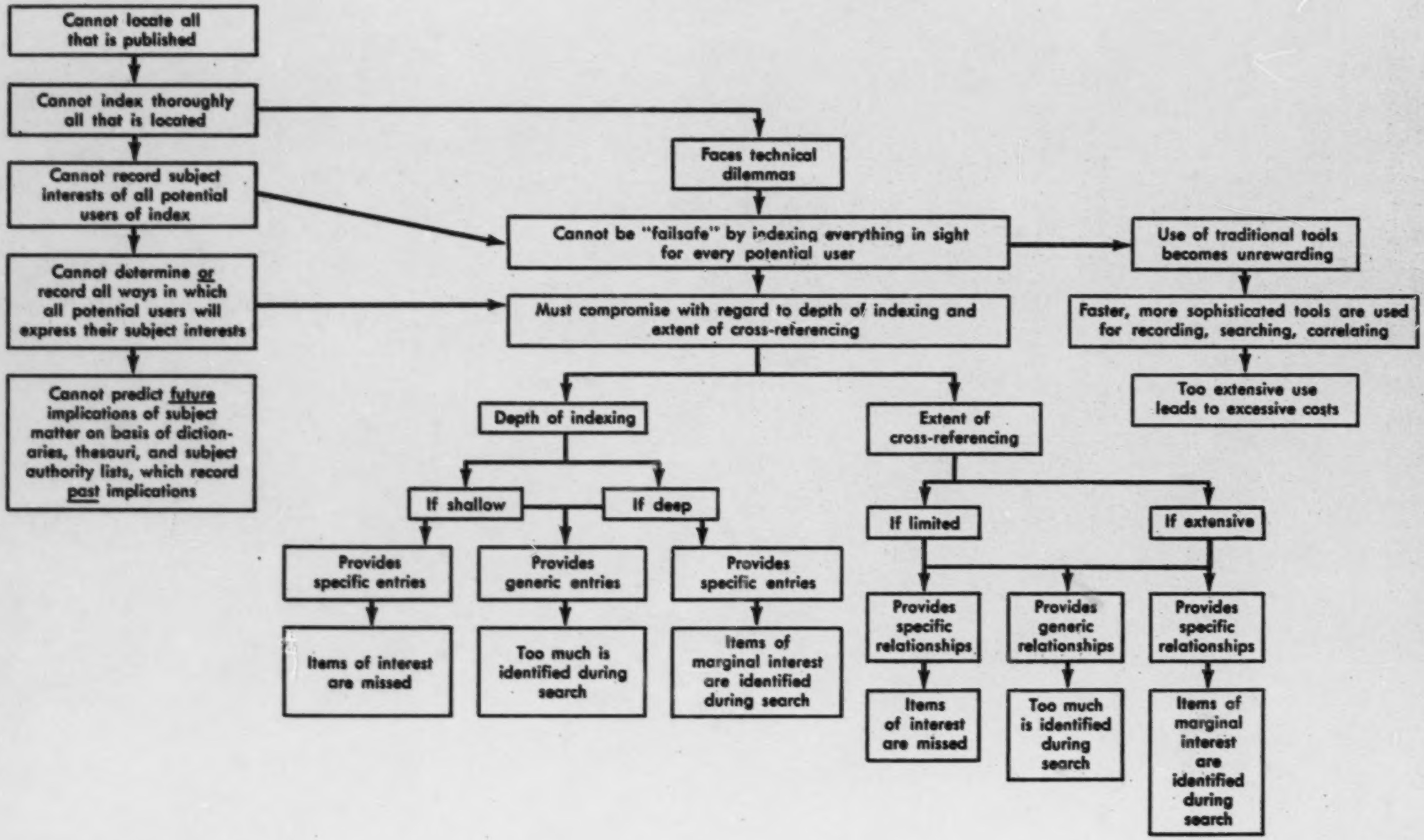

Cannot locate all that is published
Cannot index thoroughly all that is located
Cannot record subject interests of all potential users of index
Cannot determine or record all ways in which all potential users will express their subject interests
Cannot predict future implications of subject matter on basis of dictionaries, thesauri, and subject authority lists, which record past implications
Faces technical dilemmas
Cannot be "failsafe" by indexing everything in sight for every potential user
Must compromise with regard to depth of indexing and extent of cross-referencing
Use of traditional tools becomes unrewarding
Faster, more sophisticated tools are used for recording, searching, correlating
Too extensive use leads to excessive costs
Depth of indexing
If shallow
If deep
Provides specific entries
Items of interest are missed
Provides generic entries
Too much is identified during search
Provides specific entries
Items of marginal interest are identified during search
Extent of cross-referencing
If limited
If extensive
Provides specific relationships
Items of interest are missed
Provides generic relationships
Too much is identified during search
Provides specific relationships
Items of marginal interest are identified during search

Figure 1.3

THE SEARCHER'S DILEMMA

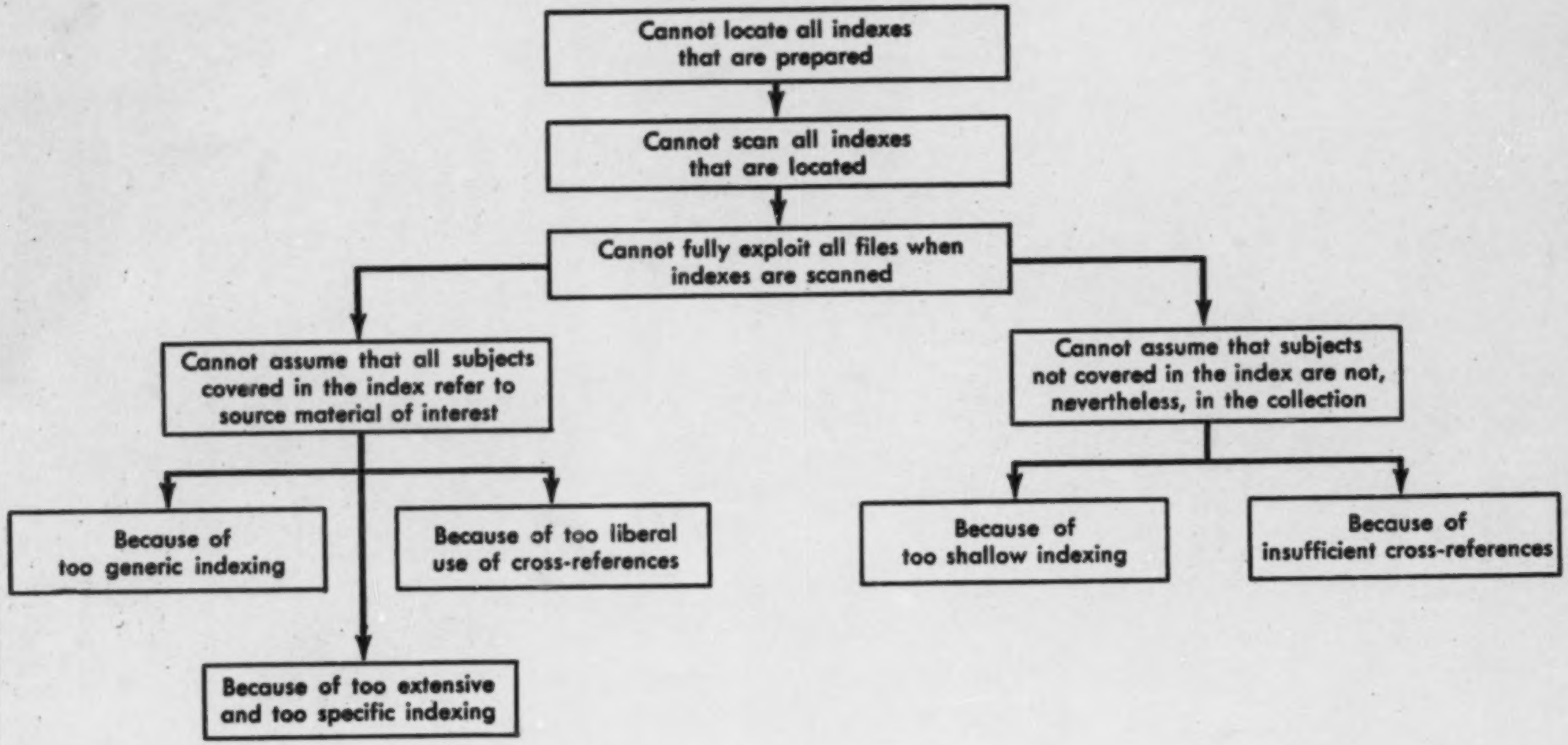
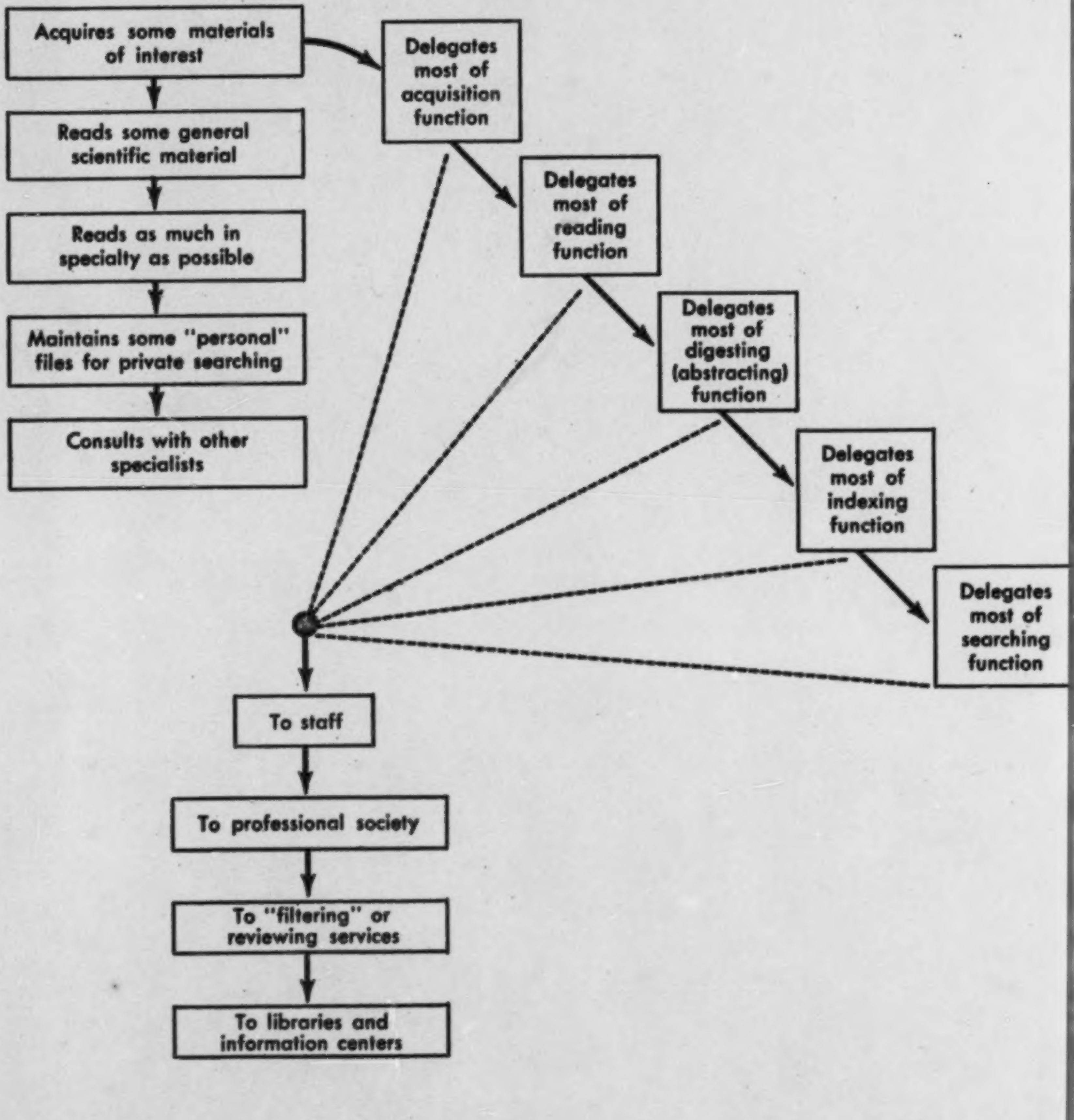

Cannot locate all indexes that are prepared
Cannot scan all indexes that are located
Cannot fully exploit all files when indexes are scanned
Cannot assume that all subjects covered in the index refer to source material of interest
Cannot assume that subjects not covered in the index are not, nevertheless, in the collection
Because of too generic indexing
Because of too liberal use of cross-references
Because of too extensive and too specific indexing
Because of too shallow indexing
Because of insufficient cross-references

Figure 1.4

The Researcher's Compromise


Acquires some materials of interest
Reads some general scientific material
Reads as much in specialty as possible
Maintains some "personal" files for private searching
Consults with other specialists
Delegates most of acquisition function
Delegates most of reading function
Delegates most of digesting (abstracting) function
Delegates most of indexing function
Delegates most of searching function
To staff
To professional society
To "filtering" or reviewing services
To libraries and information centers

CHAPTER TWO

INFORMATION RETRIEVAL IN EDUCATION

A. Information Retrieval in the Social Sciences

A great deal has been written and said about the information explosion in science and about resulting crises in the retrieval of the recorded scientific fact. Science has in this sense benefitted from the urgency of world politics and the race into space. The government and the general public have responded to this feeling of urgency by supporting programs of research into methods of documentation. Such support has greatly accelerated the development of mechanized information retrieval over the past decade.

The social sciences have not yet received the same publicity. Only recently, with increasing awareness of the importance of education in the whole pattern of social and scientific achievement, has public awareness begun to focus on the importance of educational research. Yet, as the London *Times Literary Supplement* pointed out in a front-page article on March 23, 1962:

> at the same time the sheer volume of paper published is also mounting on the non-scientific desk. Thus at a conference on *Information Methods of Research Workers in the Social Sciences*, whose report was published by the Library Association last year, Mr. Donald MacRae complained of "the difficulty of knowledge of and access to the mass of field studies and monographs" in sociology. Again an article by

> Mr. Brian Rowley in the October-January, 1961, number of German Life and Letters refers to a "jungle of secondary sources" in his subject which the bibliographers no longer have under control. Not only does research become increasingly fragmented as a result, in Mr. Rowley's view, but the young scholar, pressed to publish "original" work, may think he is doing so when ground has already been covered; he may be thickening the word-jungle to no purpose. And there are many other indications that even if the flow of new discoveries in other fields is less than that in science the problem is still the same.

The information problem in the social sciences--including education--is fourfold:

1. the delay between the reporting of bona fide research, and the reference to it in conventional abstracting and indexing reference tools;
2. the diffuse sources of relevant material, which may vary from intradepartmental memos to articles in the Saturday Evening Post;
3. the difficulty of categorizing the subjects of these reports, complicating access to their content; and
4. the inadequacy of present reference tools.

As one relates the problems of the manipulation and exploitation of recorded information in general to the social sciences in particular, the principles remain the same but certain differences emerge. For example, although it has been estimated that the total bulk of the literature of the social sciences may be considerably less than that of the physical and biological sciences, the difficulties of collecting it are perhaps more severe because it is contained in widely scattered sources and an important part of it remains virtually unavailable in unpublished form for an inordinate length of time. Another essential difference is that the potential uses for information contained in social science literature are less easily anticipated than are the uses of information contained in the natural sciences. A third rather formidable difference lies in the characteristics of the terminology of the social sciences as opposed to that of the natural sciences. This difference is often characterized by the word "soft"--as opposed to "hard"--to denote the comparative precision with which the concepts of the two fields can be defined and expressed by words. The relative "hardness," or precision, of the terminology of the natural sciences is partly the result of long historical growth during which the disciplines have been ordered. It is partly due to the nature of the matter with which these sciences deal. To the degree that a science deals with living organisms its terminology must inevitably be "softer." And in the social sciences where the matter is man and society, the highest degree of "softness" exists. In addition to the inherent difference in the nature of the concepts involved, the newness of some of the fields of the social sciences has not yet allowed the necessary time span for the development and acceptance of a universal terminology like that which exists for such older disciplines as chemistry, taxonomic zoology and botany.

There is also an important difference in the mechanism for the exploitation and dissemination of information in the two fields. Both depend to a large extent on the communication channels established by personal contact, professional societies, journals and abstracting or indexing services. These channels for communication and information tend to be intradisciplinary, whereas many of the needs for information are interdisciplinary. The need for interdisciplinary searching is probably more pronounced in the social sciences than in the physical sciences where it is well recognized.

Thus the social sciences present a challenge to information retrieval all along the way: their literatures are hard to obtain, difficult to index to any degree of sophistication, and necessarily exploitable from an interdisciplinary point of view.

B. Information Retrieval in Educational Research

Educational research exhibits all the challenges to information retrieval enumerated above for the social sciences in general. The growth of educational research and the proliferation of institutions and agencies engaged in this work have made it almost impossible to keep adequate control of the published and report information in this field, eliminating the possibility of predicting how and for what specific purposes information contained in any one document may be needed by future researchers. The terminology used by researchers is still in an exceedingly fluid and dynamic state. It has not yet "frozen" nor can it be expected even to approach stability for some time--at least until the principles and concepts of educational research become firmly established.

Research workers often need access to tools, methodology or findings which have been developed or reported on outside their own discipline.

Even if the characteristics of educational research literature and the needs of educational researchers for access to literature may be assumed, then the development of adequate bibliographic tools would still seem to be a formidable task. These tools must be able to identify and gather widely scattered pieces of literature. They must be able to shoot down a moving target, as it were, effectively meeting the problems of acquisition and terminology common to all social sciences suggested on page 10.

Public and private awareness of the need for a responsible authority to control the collection, analysis, storage and dissemination of educational research material has been stimulated, since sputnik, by publicity given to Russian achievements in education. (Cf. Arther Trace, What Ivan Knows that Johnny Doesn't, New York, 1961.) This awareness was early evidenced by the authorization, through Public Law 531 (1954), given to the U. S. Office of Education to encourage research. But as Herbert S. Conrad has pointed out,

> Public Law 531 is concerned with research, but does not mention the dissemination of research findings. One tenable view is that research without dissemination is incomplete and, indeed, pointless. On this view, dissemination is quintessential, and should be 'built into' any valid research methodology.
>
> (Herbert S. Conrad, "Contributions of the Federal Government to Educational Research Methodology," First Annual Phi Delta Kappa Symposium on Educational Research, Bloomington, Ind.: 1960, pp. 39-40.)

Under Title VII of the National Defense Education Act of 1958, "Research and Experimentation in More Effective Utilization of Television, Radio, Motion Pictures, and Related Media for Educational Purposes," further dramatic steps have been taken toward the goal of effective documentation of research. Part B of Title VII specifically calls for the dissemination of information concerning research and teaching programs and practices involving the new educational media.

In 1960, aware of the inadequacy of current bibliographic coverage and control of the literature of educational research, the U. S. Office of Education sponsored a survey of the availability of bibliographic references to one portion of this literature (educational media) as part of a study of the feasibility of establishing an information service for educational media research.*

To check the control of information on media literature the authors searched the available indexes, bibliographies and lists for reference to 330 titles of acknowledged relevance to educational media.** These titles were searched through the standard bibliographic tools of education literature: periodical indexes, abstracting journals, annual bibliographies, indexes to government publications, lists of dissertations, national and general bibliographies, and subject bibliographies. The study showed that 56 of the 330 titles (16.97%) were included in none of the bibliographic tools available to researchers in education. The most obvious conclusion was the need for better bibliographic control, in order to make research on media more readily available to the researcher. Messrs. Tauber and Lilley also obtained data by questioning researchers in media as to their manner of keeping abreast of their field. The answers reflected the dissatisfaction of the users with the bibliographic resources currently available. The conclusions reached by the authors were that there was a need for better information service and that the establishment of such a service was feasible.

---

* Feasibility Study Regarding the Establishment of an Educational Media Research Information Service, by Maurice F. Tauber and Oliver L. Lilley, School of Library Service, Columbia University, New York, 1960.

** The source of these titles was a bibliography entitled Audio-Visual Communication Research, by William H. Allen, System Development Corporation, 1958. This was later published as a list of 320 references to Allen's article, "Audio-Visual Communication," in the Encyclopedia of Educational Research, 3rd ed., ed. Chester W. Harris, The Macmillan Co., New York, 1960.

The sponsorship of the Tauber-Lilley study is far from the only evidence of concern on the part of the Office of Education in this field. The present report is certainly testimony to this statement. The need for an information service remains. As was pointed out in 1960 by Margaret R. Sheviak and Haynes McMullen in "Research Tools: Access to the Literature of Education," appearing in the Review of Educational Research (XXX:5, Dec. 1960, p. 487),

> There have been no startling changes during the last three years in the bibliographical apparatus for obtaining access to the main body of educational literature,....

Today, eighteen months later, the operational state of the art remains the same. Yet the optimistic conclusion of the authors is worthy of inclusion here:

> ...but two trends are likely to be of considerable interest in the future. The first is the increasing amount of information available about educational systems outside the United States; the second is the development of machines and systems of searching which permit quick access to ideas and combinations of ideas not easily located through conventional bibliographies, indexes, or abstracts.

The Center for Documentation and Communication Research is herewith presenting evidence of such development. It is to be hoped that the next review of "The Methodology of Educational Research" in the Review of Educational Research for the three-year period ending December, 1963, will include an announcement of the establishment, within the U. S. Office of Education, of an Educational Research Information Center, based on the guidelines laid out here.

In April 1961, the U. S. Office of Education awarded a grant to the Center for Documentation and Communication Research, Western Reserve University, for the purpose of establishing the pilot information service to which this report is devoted. The project called for

1. acquiring a collection of documents;
2. processing the collection; and
3. testing and evaluating the pilot system.

These tasks were completed early this year. The work accomplished on each task will be discussed in detail later in this report and in the appendices. Before further discussion of the specific tasks, however, a general discussion of information systems and the unit operations comprising information systems can provide the framework within which to discuss the tasks completed under the terms of this grant.

CHAPTER THREE

INFORMATION SYSTEMS

Information retrieval systems, whether within or without the library, start with a practical consideration. They have been created because it was impractical, inconvenient, or excessively expensive to locate records personally. Usually the "size" of the file or library (as measured by the number of records it contains, extent to which each record is analyzed, or the complexity of subject matter) has reached the point at which a personal retrieval system is no longer adequate. (See Figures 1.1-1.3, accompanying Chapter One.)

When a file reaches this size, it is probable that too many records are being incorporated into it for any one person to remember them all, or even to inspect them all. Therefore, in delegating the remembering and inspecting functions to others, the researcher will present a request to the file which is expressed in terms of his subject interest. Further, when he states such a request, his choice of terminology will be strongly influenced by his own background and vocabulary and not by the text of the records in the file.

Therefore, when a search is to be conducted in response to such a question, it is necessary for the questioner to:

1. Predict the vocabulary of authors probably unknown to him and

the terminology they have employed in dealing with matters that interest him.

2. Predict the terminology with which delegees (librarians or documentalists) probably unknown to him have chosen to analyze these records.
3. Predict which symbols or other clues were used by delegees (librarians or documentalists) to record the results of their analyses.

It is obviously difficult for the questioner to predict all these possibilities accurately. If he is to be successful in locating the records relevent to his need, he may have to formulate his question at a high level of generality, or express it in several different ways. Such expedients may, and generally do, result in the delivery of many documents that are irrelevant to his search. Thus, regardless of means used, a considerable compromise with the "ideal" is inevitable.

The questioner's delegees (the librarians or documentalists), if they are to discharge their responsibilities and keep the extent of compromise to the minimum, engage in a number of unit operations, ranging from acquisition through delivery of documents. These unit operations are presented in Table 3.1, columns 1 and 2, following page 22.

Every search is conditioned by certain limitations, and the results of the search must be a compromise between the ideal and the practicable.

1. Intellectual Limitations

   The precision with which the search is performed cannot exceed the precision of the language with which knowledge is recorded.

2. Operational Limitations

   The theoretical ideal may not be realized because of economic and time limitations that dictate arbitrary operating short cuts.

3. Cooperative Limitations

   Many cooperative arrangements are not possible because of lack of knowledge of work being done elsewhere and the inability to reconcile technical differences in operational techniques and methods.

4. Human Limitations

   Many objectives cannot be realized because of error, carelessness, inconsistency, and lack of training and experience of those responsible for technical functions.

These limitations are presented in some detail in Table 3.1, columns 3 to 6.

Despite the limitations outlined above, certain pragmatic approaches to information retrieval have proved to be increasingly useful. The developments at Western Reserve University and elsewhere are set forth in columns 7 and 8 of Table 3.1.

In general, these newer approaches may be briefly listed as follows:

1. Improved analysis of source documents increases the efficiency of subject retrieval.
2. Computers and computer-like devices are being used to improve the effectiveness of content analysis at lower unit costs.
3. Increased attention to problems of terminology is helping to characterize the subject content of documents. Terminology is recorded in computer-searchable form at decreasing unit costs.
4. Studies are being made of the relationships and associations inherent in the subject content of documents. These relationships

and associations are recorded in computer-searchable form to improve precision in document selection.

5. Attention is being given to formalizing search strategies to provide a greater depth of analysis with computer-based processing of the literature.
6. Improvement is being made in the speed of search and correlation through the use of computers and computer-like equipment to increase the economy of routine tasks.

There is no simple, direct method for determining the effectiveness of an information service. Exact measurements cannot yet be made of all the factors involved. Techniques for measuring effectiveness are being developed,* though no fully satisfactory systematic methodology has yet evolved. However, there are certain criteria in relation to which a system may be considered. These are:

1. Relative user-satisfaction, expressed by:
    a. questioners who have experienced meager or inadequate bibliographic service, either within their own specialty or outside of it, in previous attempts to gain control of the literature.
    b. questioners who have had adequate control over the literature of their specialty.
2. Completeness of coverage of the literature.

---

* See Cyril W. Cleverdon, The Evaluation of Systems Used in Information Retrieval. International Conference on Scientific Information (Preprints), (Washington: 1958), Section 4, pp. 25-36. See also B. C. Vickery, Classification and Indexing in Science, 2nd ed. (London: 1959), p. 149.

3. Sufficient depth of analysis of the subject content of the literature, in terms of the number of points of access provided, measured as a function of the successful performance of the searches that are desired.
4. The precision of the search in relation to the ratio of good to bad answers. The ideal system which can provide all "good" answers without providing any "bad" answers can probably never be attained, because the value of a document provided as an answer depends not only on its factual content, but also on certain subjective responses of the questioner to the total document. In any system a certain amount of "noise" is unavoidable. However, a system to be effective should provide a sufficient number of good answers to inspire confidence in the completeness of the search while providing no more than a tolerable number of irrelevant answers. The system's ability to provide a favorable ratio of good to bad answers depends upon the controls which are provided in its design.
5. The timeliness of the material made available. The ideal system would receive written material immediately upon completion of the manuscript--even before publication--and would process it immediately so as to make it available in response to questions. Whenever there is a pressing need for researchers to be informed of the latest research, timeliness becomes an important criterion.
6. The speed of the system in responding to requests.
7. The adequacy of the form in which responses will be presented, i.e., either as:

a. bibliography of titles;

b. abstracts

  (1) annotations

  (2) informative abstracts;

c. full documents.

8. The cost of the system as dependent upon the value assigned to the other criteria.

Table 3.1 (following page 22)

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INFORMATION RETRIEVAL—UNIT OPERATIONS

UNIT OPERATION	FUNCTIONS PERFORMED	PROBLEMS INVOLVED IN PERFORMANCE				RESEARCH AND DEVELOPMENT ACTIVITIES		
		INTELLECTUAL	OPERATIONAL	COOPERATIVE	HUMAN	PERFORMED AT WESTERN RESERVE UNIVERSITY	PERFORMED BY OTHERS IN THE FIELD	TO BE PERFORMED
I. Acquisition	Location, selection, ordering and receiving of source materials for a collection.	Identification of shifting interests of a changing clientele to yield a formal policy that can be followed consistently.	Learning of the existence of obscure materials, or even of mass produced items, since producer often cannot identify probable clientele for direct notification of availability.	Much unnecessary duplication of effort in acquiring materials when many organizations have overlapping interests.	Lack of consistency of acquisitions staff in executing amorphous and shifting policy.	For intellectual portion of the task, acquisition has been considered related to analysis (which see). Empirically, traditional techniques, but highly cooperative in nature, have been used.	"Profile" of interests (acquisition policy) developed to permit ready (and automatic) matching of available materials against clientele interests. However, this skirts problems of analysis (which see) with which it is integrally related.	Examination of source materials in order to determine whether to acquire or not, is analogous to type of analysis for indexing, classifying, etc. Therefore, see **Analysis** below.
II. Analysis	Perusal of source documents and selection of points of view (or analytics) that are considered to be of sufficient probable importance to warrant the effort of rendering them searchable in the system.	Prediction, based on examination of source materials, of what aspects are of current and lasting interest. The two points of view not always compatible.	See sub-unit operations (indexing, classifying, etc.) below.	Same source materials are often processed by more than one agency in order to represent special points of view.	Level of subject matter knowledge of analyst cannot usually be matched to that of user. Question of whether analyst should be a specialist or a generalist. Specialist not often available or interested in analysis as a professional activity, nor can specialist often discern interdisciplinary interests of a wide spectrum of users. Generalist, on other hand, cannot often fathom detailed specialist needs.	Two types of abstracts are produced as the result of a single analysis of source materials — conventional and telegraphic. Latter provides ability to record "index" entries; to classify related information; to provide links and roles between related subject matter; to provide as much penetration of subject contents of document as may be desired and as is economically feasible. This permits facts to be recorded with a minimum of interpretation, and permits search for special correlations from multiple points of view without need for predicting future requirements in this regard.	Various types of analysis are being conducted which represent different levels of penetration of subject contents of source materials and various modes of expression of these subject contents. These levels represent spectrum from no processing (recording full text for search and reserving decision as to type of processing for search operation) to extremely formal or artistic processing by human or machine methods.	Formalization of rules for analysis to remove the activity from the "artistic," and to permit expression of subject content in a more rigorous and consistent manner. Machine interpretation of natural language text (either full text, or abstracted text) in order to obtain machine-processable normalized text.
a) Abstracting	Concentrating the essential qualities of a larger thing—a summary of a publication accompanied by an adequate bibliographic description, to enable the publication to be traced.	Same as above.	Abstracts, as written by authors, and as published with articles are usually used "as is" or with minor modifications, regardless of field which abstracting agency represents. Timeliness.	Special points of view are not always reflected in the resulting abstracts. However, noncooperative attitudes remain.	Same as above. Also, use of specialists usually leads to delays in producing abstracts, so that authoritativeness is gained at the expense of timeliness.	Same as above.	See above. Also various types of abstracts are produced, e.g., annotative, informative, representing different levels of penetration into subject contents of source material.	Same as above. In addition, need to develop methods for automatically processing previously prepared abstracts to yield machine-searchable stylized abstracts or indexes. Need to resolve question as to whether single abstract or index can serve enough purposes to permit cooperative processing. Require controlled experiment to compare results of various levels of penetration, prepared by persons of varying levels of background.
b) Indexing	Selection of words or ideas from a graphic record on the basis of well-defined rules, in order to facilitate the identification or selection of desired records after they have been stored.	Involves further abstraction of the contents of source materials, which leads to the need for exercise of value judgement as to most appropriate analytics.	For most ways of "storing" indexes, cost is a direct function of number of index entries to be stored, and for searching the indexes the cost increases exponentially with increasing number of entries. For some mechanical means, the cost of searching each incremental entry increases only directly.	Indices prepared by different agencies use different policies, so that exploitation using common strategies is impossible.	Difficult to reconcile fact that indexer selects entries based on examination of source text, and must predict what users, separated by time, space, and often culture, will find of interest	Same as above.	Use of clerical or automatic methods to generate indexes on basis of keyword permutations, statistical occurrence of substantive words of source texts. Assigning of values for various words as an aid in later searching (probabilistic indexing). Falsely-equates words of text with ideas of users; occurrence of word with importance for retrieval purposes.	

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			incremental entry increases only directly.					
c) Classifying	Arranging or placing in a class on the basis of similarities or differences.	Special vs. general purpose classification. No "logical" system can be developed, only functional for one or more points of view. What serves one well, serves another less well, poorly, or not at all. Analogous to problem of terminology control (which see), except that classification implies organization of knowledge starting with the generic and proceeding to the specific.	Attempt is made, without universal success, to serve mental orientation of majority of clientele by generalizing classification system sufficiently to avoid having some very special points of view being served too well at the expense of others.	Special classification systems prepared from special points of view are seldom compatible. Attempts to reconcile them often result in monstrosities. Cooperation inhibited because spectrum of generic and very specific points of view to be expressed for a wide range of interests, and for varying amounts of detail, leads to greater cost for each cooperating agency than they usually are ready to pay.	Same as above.	Generic and specific meaning of terminology has been represented by "semantic" factors which provide analogy to ability of a classification system to organize material over a range of specificity to generality.	Many special classifications have been prepared from individual points of view. A "universal" classification has been prepared and is under revision. Faceted classification approaches have also been developed.	Rigorous investigation of the discriminatory power of each type of classification system as a function of file size and type of subject matter.
d) Extracting	Selecting for quotation portions of source material.	Preprogramming of machine, clerical, or technical aids requires decisions as to criteria for extracting—which cannot be selected appropriately until criteria for determining pertinence and relevance are established.	Often selected on basis of haphazard extraction of all or portion of existing summary, abstract, or conclusion. Otherwise purely arbitrary criteria are used.	See **Abstracting** above.	Subject understanding is relegated to low level, often so low that extracting is no longer an analysis technique. Therefore, analytical problems are often being postponed to the exploitation operation.	This approach has not been used, since it has been considered as unrewarding during the present stage of research.	Autoabstracts (extracts) are prepared on the basis of selection of sentences which have highest numbers of keywords (i.e., highest number of words which are not on an "exclusion" list).	Key words used as basis for selection of extracts are seldom "key" or suitable for "indexing" important aspects of subject matter. Work needed to evaluate relevance and pertinence as a function of the coincidence of words in questions and in source text.
III. Terminology Control	Establishing arbitrary relationships among analytics, e.g., based on similarities among analytics as revealed in dictionary definitions.	Meaning of terminology shifts with usage in other fields and among different cultures. Problems analogous to those of classifying (which see), except that organization of knowledge in this case proceeds from the specific to the generic by recognizing interrelationships as represented by synonyms, near-synonyms, or overlapping meaning.	Compromises are made because every implication of possible usefulness can neither be discerned nor recorded economically. Those implications omitted lead to material missed during a search; those included extraneously lead to material being selected during a search that is irrelevant to some special points of view.	Same problem as for Classifying (which see). Meaning shifts at different rates and in different directions for different fields.	Different individuals have different ideas as to what relationships between terms are important, and what words mean. These ideas depend upon background, training, language and culture, and interdisciplinary exposure.	Related to analysis, classifying, and search strategies (which see).	Various agencies have developed control mechanisms, such as subject authority list, classification systems, thesauri, cross reference systems, etc.	Association tests and linguistic atlas may be used as basis for predetermining shifts in meaning to permit taking preventative steps rather than reacting after the fact. Development of mechanical code dictionary to act symbiotically with computer to permit economical handling of shifting associations.
IV. Recording of Results of Analysis on Searchable Medium	Use of a card, tape, film, or other medium, on which the analytics are transcribed.		Decision to be made whether or not to separate "index" from source document on search medium. Also, medium to be selected that matches volume search, etc. of requirement. (See also **Conducting of Search**).	Common language with other recording media to be considered. Need to reconcile with availability of different equipment at different organizations.		Automatic methods have been developed for encoding and recording on magnetic tape (B.C.D.), to be compatible with large percentage of available digital computers. Decision made to separate index from source documents.	Wide variety of noncoordinated methods and media are being used.	Need to develop engineering criteria for decisions as to common language, alternate media, etc. Empirical data to be generated, from which conclusions may be drawn.

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	definitions.	(which see) except that organization of knowledge in this case proceeds from the specific to the generic by recognizing interrelationships as represented by synonyms, near-synonyms, or overlapping meaning.	plications omitted lead to material missed during a search; those included extraneously lead to material being selected during a search that is irrelevant to some special points of view.		pend upon background, training, language and culture, and interdisciplinary exposure.			
IV. Recording of Results of Analysis on Searchable Medium	Use of a card, tape, film, or other medium, on which the analytics are transcribed.		Decision to be made whether or not to separate "index" from source document on search medium. Also, medium to be selected that matches volume search, etc. of requirement. (See also **Conducting of Search**).	Common language with other recording media to be considered. Need to reconcile with availability of different equipment at different organizations.		Automatic methods have been developed for encoding and recording on magnetic tape (B.C.D.), to be compatible with large percentage of available digital computers. Decision made to separate index from source documents.	Wide variety of noncoordinated methods and media are being used.	Need to develop engineering criteria for decisions as to common language, alternate media, etc. Empirical data to be generated, from which conclusions may be drawn.
V. Storage of Source Documents	Physical placement of record in some location, either in original form, or transcribed or copied onto a new medium.		**See Recording** above. Full size storage too bulky for large collections; need for rapid copying of records on demand, and of portions of whole collections for local use.	Size and form of microprint must be standardized for convenient cooperative use.	Use habit surveys have shown no universal desire for microform storage.	Empirical progression of techniques from photocopy to microform storage.	Methods used have been a function of commercial sales pressures.	Need for systems — oriented storage device to be developed on a modular basis which integrates with a wide variety of input - output media.
VI. Question Analysis and Development of Search Strategy	Expression of question or problem, selection of analytics in terms of a particular search mechanism, and arrangement into a configuration that represents a probable link between the question as expressed and the records on file as analyzed.	Selection of analytics requires prediction of how ideas were expressed by analyst in terms of what appeared in the source documents.	Formulation of scope, terms, and logic of questions in terms of best guesses often leads to miscommunication between questioner and system operator.	Exploitation of files required which were generated with varying depths of analysis, varying index systems, and different machine languages.	Achieving agreement between questioner and analyst with regard to scope of search usually involves different subject backgrounds and motivations. Often leads to lack of full transfer of desires of questioner.	Exploitation of boolean functions on alternate strategy basis.	Often involves formulation of "standard" questions, or ignoring the problem by equating search satisfaction by a source document, to concurrence of words between question and document.	Development of a large amount of empirical results of alternate search strategies, and optimizing strategies on basis of results.
VII. Conducting of Search	Manipulation or operation of the search mechanism in order to identify records in the file.	Mechanism used can influence decisively the functions that can be performed conveniently. Functional limitations may join forces to influence intellectual scope of a search.	Depends on mechanism chosen; for example, decision regarding inverted or sequential form influenced by search device used.	Use of different search mechanism without common languages (machine and intellectual) has inhibited cooperative activities.		See **Recording, Storage,** and **Question Analysis.** Have used general purpose computer, sequential file arrangement, and multiple searches.	See **Recording** and **Storage.**	Investigation of limits of sequential and inverted file arrangements. Optimalization of file division techniques.
VIII. Delivery of Results of Search	Physical removal or copying of record from file in order to provide it in response to a question.	Related to storage of source documents (which see).	Related to storage of source documents (which see).	Related to storage of source documents (which see).	Related to storage of source documents (which see).	Related to storage of source documents (which see). Converting files to aperture cards to permit convenient copying of images on demand.	Related to storage of source documents (which see). Many have recorded index and source documents on same medium (e.g., files).	Related to storage of source documents (which see). Need for faster searches, faster delivery, more convenient microform techniques.

CHAPTER FOUR

PILOT INFORMATION SERVICE FOR EDUCATIONAL RESEARCH MATERIALS

A. Objectives of Pilot Program

The objective of the pilot program undertaken by the Center for Documentation and Communication Research under the sponsorship of the Office of Education has been to develop an information retrieval system which will permit the detailed analysis and selective dissemination of educational research material, based on individual interests and requests. The accomplishment of this overall objective has been achieved through three plans of endeavor.

1. The development of a pilot system for educational research literature.
2. Tests and evaluations of the system at various stages of development by:
    - a. internal evaluation;
    - b. evaluation by trial users;
    - c. evaluation by subject experts other than the questioner;
    - d. comparison with other systems.
3. To apply the results of tests and evaluations to improve the pilot system and prepare for further development of an operational system.

These objectives were stated in the contract providing support for this effort as a set of individual sub-tasks as follows:

Task 1. Select a sample of not less than 2,000 educational media research reports and 2,000 documents of general educational research.

Task 2. Investigate alternative approaches to the analysis of subject matter in the documents selected.

Task 3. Analyze the terminology representative of the field.

Task 4. Develop a pilot system of analysis; code and process a portion of the documents selected; and test and revise the media classification system.

Task 5. Pre-test the pilot system through an investigation of user requirements and an inputting of potential questions representative of those with which such a system will be required to deal.

Task 6. Evaluate alternative documentation systems and equipment with regard to anticipated benefits and attendant costs, and select an optimum system.

Task 7. Complete the processing of the representative sample of documents and field-test the system by processing a sample of questions representative of potential users.

Task 8. Prepare manuals for the analysis and coding of documents for inclusion in the system and for querying and otherwise retrieving information from the system.

B. Procedures

1. Problems

In starting to develop an information service for educational research, there were decisions to be made regarding the applications of the basic principles of information retrieval to the literature of the field. Specifically, a decision had to be made as to the depth to which the subject content of the literature would be analyzed. A decision had to be made as to the extent of terminology control to be exercised. And a decision had to be made as to what type of mechanism should be used for the storage of the indexes to the literature and for conducting the search.

It should be noted that the variables affecting these decisions are dependent upon the users who at the outset of the development of a system are unknown to the systems designer.

2. General Methodology and Approach

Since all the variables which will affect the ultimate design of an information system are not known at the start,* the initial approach to setting up a system must be essentially intuitive (aided by experience) with ensuing research effort devoted to the accomplishment of successive approximations toward optimal functioning of each of the unit operations of the system--acquisition of materials, analysis, terminology control, storage, searching, and delivery of results. For the pilot phase of this project, the initial decision we made regarding the three central unit operations--analysis, terminology control, and searching--was to provide:

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* See also, Allen Kent, Textbook on Mechanized Information Retrieval, Chapter 8, Interscience Publishers, Inc., New York, 1962 (in press).

a. Analysis of subject content significantly deeper, more detailed and more flexible than that provided by existing systems.

b. Control, or cross-referencing, of terminology more flexible and more interdisciplinary in nature than that provided by existing systems.

c. A mechanism for exploiting the body of literature indexed in the manner described above which will permit the system to function on both a centralized and decentralized basis.

C. Procedural Steps

The tasks involved in the development and testing of the pilot information system were completed as follows:

1. Collection of a Sample Library

a. Definition of Educational Research Study

A prerequisite for the collection of a sample library was a tentative definition of Educational Research which would establish the conditions necessary for a study to be relevant to this project. These conditions then became the criteria for inclusion of documents in the pilot collection. The investigators were substantially aided in formulating such a definition by subject experts representing various fields of educational research and by members of the Office of Education. The following tentative definition has evolved to be used as the guide for acquiring materials:

"For the purpose of the establishment of a pilot information service for educational research materials, educational research is considered to be empirical investigation of a problem having explicit relevance to organized education. In order for a study to be considered educational research the following conditions must obtain:

(1) It must report systematic investigation.

(2) It must be generalizable beyond the local setting of the study.

(3) It must permit prediction.

(4) Its findings must be quantified.

(5) It must contain either primary data or integrative secondary data.

(6) It must be verifiable, in that it reports

  (a) the validity and reliability of the data

  (b) analysis of the data

  (c) findings and conclusions."

Examples of studies conforming to these criteria are:

(1) Reports of single experiments which provide findings allowing prediction with a stated degree of confidence.

(2) Statistical surveys, longitudinal or normative.

(3) Reviews of two or more related experiments or statistical studies.

(4) Proposals for experimental studies or surveys.

(5) Historical trend analysis, supported by collected

data, which allow generalizations beyond the immediate subject of study.

(6) Case studies which provide generalizable findings.

b. Size and Scope of Pilot Library

The grants supporting this project permitted the pilot library to contain at least 4,000 documents. The support was given by both Title VII of the National Defense Education Act and the Cooperative Research Program, and it was a condition of the grants that of the 4,000 documents 2,000 should pertain to educational media research and 2,000 to other Cooperative Research Program interests, in order that the investigators might build a unified concept for the future inclusion of literature relating to the whole scope of educational research.

c. Period of Coverage

It was decided that the collection of documents for the pilot library should begin with current publications. Therefore the 2,000 documents in educational research in general (exclusive of media research) represent a sample of research literature produced mainly within the time span of the pilot project (1961-62). However to acquire 2,000 documents on audiovisual media research conforming to the criteria established for inclusion in the sample, it was necessary to go back to 1952. Thus the 2,000 documents on media represent a ten-year research production in this field.

d. Procedures for the Identification and Acquisition of Relevant Material

The first step in the acquisition effort was the derivation of a list of periodicals to be scanned, based on the sources represented in the bibliography on audiovisual media prepared by William H. Allen for the Encyclopedia of Educational Research, Third Edition (1960).

The journals from this list were scanned for the first half of 1961; relevant articles on media and other aspects of education were selected and photocopied so that they could be circulated to abstracters and subsequently stored at the Documentation Center.

The first selections were made before the criteria of research quality had been established. As a result, a small portion of the documents in the file do not qualify as research according to the criteria given above. However, the total file now contains more than enough documents over 4,000 to make up for this portion.

A work-sheet form was designed on which the results of scanning were recorded. Subscriptions were placed for those journals found to contain several useful articles in each issue. Those journals found to yield almost nothing of value were dropped from the scanning list. Study of the major periodical indexes led to some additions to the scanning and subscription lists, largely to provide coverage of aspects of education other than audiovisual media, which were of course not fully represented in the source bibliography.

Soon after the study was started, subscriptions were placed with the National Education Association for all of their periodical and serial publications provided to libraries under Plans I and II.

As the study has progressed, experience with the journals, follow-up of bibliographic citations in articles, clarification of the selection criteria, and suggestions from subject specialists have led to further changes in the scanning and subscription lists by addition or deletion. It has been decided tentatively, for example, not to renew the group subscription plans with NEA, but to subscribe individually to the eight or ten journals which publish reports, reviews or abstracts based directly on research activities, and to rely on citations in these journals for reference to appropriate serial publications. Most of the NEA departments publish two periodicals, one for researchers and one for practicing teachers and administrators; in most cases the latter was found to contain nothing suitable for inclusion in a file which is being designed to serve researchers.

e. Evaluation of Periodicals

To evaluate the appropriateness of the list of periodicals being scanned, on March 2, 1962, a list of journals received on subscription and/or currently being scanned was sent to each of the advisory group of specialists who had met in Atlantic City on February 19, 1962. We asked them to give their evaluations of the journals by placing them in the following categories:

(1) Wholly useful (WU) -- every issue contains several articles which report or review studies of adequate research design which are relevant to some area of organized education.

(2) Occasionally useful (OU) -- at least three issues a year contain at least one article which reports or reviews studies of adequate research relevant to some area of organized education.

(3) Never useful (NU) -- publishes relevant and adequate material so rarely that it is not worth periodical scanning. It can be assumed that anything of importance which might appear in such a journal would also appear elsewhere in adequate or more useful form, or would be noted in some regularly available bibliographic reference.

(4) No judgement (NJ) -- far removed from evaluators own area of specialization.

Responses received to date and our own tentative decisions are tabulated in Appendix A, page 127.

A more complete analysis will be presented in a forthcoming progress report on Cooperative Research Project No. 1517, "Identification of Source Materials for an Information Service of Educational Research Materials," which is an exhaustive study of sources of educational research materials for an operational information service.

f. Other Serials, Monographs and Reports

In August, 1961, a comprehensive card-file bibliography on audiovisual media, covering over 60 years, was received from the Division of Academic Research and Services, Pennsylvania State University. The references from this file provided a significant contribution to our effort to acquire 2,000 research reports on audiovisual instruction. It also alerted us to important additions to our subscription and scanning lists, and led us to valuable sources of unpublished monographs.

To investigate significant research literature in education existing only as unpublished monographs of limited availability, a form letter was sent in September to organizations and individuals engaged in research and connected with universities, branches of the armed services, industries, etc. (Responses to the form letter are given in Appendix A, page 140.

g. Use of Indexing and Abstracting Services for Identification of Relevant Material

Several relevant periodical indexes and abstract collections have been studied, but, with a few exceptions, have been found unsuitable for regular scanning to identify current literature because of the time lapse involved. Furthermore, the necessity of following the various cross-references involved in conventional literature searching, as required when using the periodical indexes, limits their use as an acquisitions tool for a collection of literature on many aspects of educational research. However, indexes and abstract collections have suggested new journals and new sources of unpublished material. The final plan evolving from this project was to make regular use of only six of the group originally considered, namely

(1) Psychological Abstracts, mostly for access to foreign literature,

(2) Education Abstracts, (UNESCO), also for access to foreign literature,

(3) Cumulative Book Index, which might occasionally cite something not found in other available bibliographic reference lists,

(4) Current Contents, which allows easy scanning through the Tables of Contents of some journals in peripheral areas which publish pertinent material too infrequently to be worth scanning individually,

(5) Content, a collection of Tables of Contents published by the Education Centre Library of the Toronto Board of Education, for referral to Canadian and other foreign educational journals, and

(6) Sociological Abstracts, for access to foreign literature and other documents of limited availability.

2. Conventional Abstracts

The term "conventional abstract" is used generally throughout this Report to distinguish an English-language summary of a document from the detailed, highly formalized, computer-searchable index which is the telegraphic abstract. More specifically, the conventional abstract is a paragraph prepared to show:

a. Bibliographical data for the original document

b. Significant contents of the original document:

    (1) Purposes of study

    (2) Procedures of study

    (3) Findings of study

The conventional abstract is prepared to serve as the "product" of the search. As such, it is temporarily serving as a substitute for the original document, although it is not the intent of this system to provide abstracts which will make it unnecessary for the user ultimately to read those documents he finds of primary importance to his work. The questioner who receives a copy of the conventional abstract must determine on the basis of that summary whether the conception, design, procedure, and results of the research reported to him in answer to his question are in fact a contribution to his knowledge of the field.

For this reason, the conventional abstract must be more than an annotation of the bibliographical reference. The abstracter must indicate clearly the adequacy or inadequacy of the research without assuming the role of critic. For the same reason, his abstract must represent a measuring of the original document against certain specified criteria, and a reporting of how it measures up. The conventional abstract cannot, therefore, be an author's abstract or an extract from the document since, in these cases, the bias of the summary will not be above reproach.

In the Pilot Project, and in the routines of the Educational Research Information Center as it is visualized at this time, the conventional abstract serves only the purpose stated above: to substitute for the original document as the product of a search.

As the service expands, however, and as it takes on added dimensions, the Center will be able to provide bibliographies on specified aspects of the field, generated either from retrospective searches which have been run in response to client requests, or from searches run for the purpose of such compilation by the Center staff. The availability of conventional abstracts will give a depth of usefulness to such bibliographies when annotated lists would prove inadequate for the purposes of the user.

Similarly, a "current-awareness" alerting service can be organized around the continuing supply of these abstracts as provided by the regular internal routines of the Center.

For a full discussion of the conventional abstract as developed for educational research materials and for examples of its application, see Appendix B, pp. 150 ff.

3. Analysis of Sample Collection

   a. Analysis in Depth

      At the outset of this project the basic decision had been made to provide an analysis of the subject content of the documents in this collection which would be significantly deeper than that of existing systems.

      We made this decision for two reasons:

      (1) Since the information needs of the research community who would find this literature useful

were unknown to us, a rigid, generalized scheme designed a priori for recording the characteristics of the literature included in this project might not have served the actual needs of individual users and would force them to use the system in a stereotyped way. A scheme for recording the specific details of content would, on the other hand, permit the system to be queried in a variety of ways--all of which would not have to be anticipated at the outset of the project.

(2) In undertaking research such as is involved in the establishment and testing of a pilot information service, this decision has created an experimental laboratory situation in that it has provided material on which can be performed a variety of controlled investigations. By having recorded more details of subject content than have been recorded in other indexing systems for educational research literature, we are now in a position to simulate systematically the depth and flexibility of a wide range of systems designed to exert bibliographic control over the literature relevant to educational research.

Thus deep analysis of the subject content of the documents processed for the pilot project provided the means whereby we could work toward the achievement of one of the primary objectives of the project--the determination of

optimum depth of analysis to permit the selective identification and dissemination of educational research materials to individual users. (In order to arrive at a valid determination of optimum depth of analysis, it is also necessary to query the system with many, many questions reflecting these needs. This factor is discussed in Section 6b, on page 52.

b. Tauber-Lilley Faceted Classification and Other Schemes

The task of developing a flexible scheme for indexing in depth was made much easier by the previous work of Maurice Tauber and Oliver Lilley. The tentative faceted classification scheme which they developed in the course of their investigation of bibliographic resources for audiovisual research provided an intellectual framework which was generalizable to the entire field of educational research. This framework was used by the Center for Documentation as the basis for the organization of a more flexible indexing scheme which could provide for the recording of specific details of the full range of documents in the pilot collection. Many other indexing and classification schemes were also examined. Examples of these are given on page 75 . Each previous effort served to elucidate the relationships of various aspects of educational research to the discipline as a whole, and enabled us to examine our scheme for its ability to make provision for the various specialized studies.

c. Telegraphic Abstracts

The approach to analysis of subject content which was applied to the documents of this pilot collection is called the telegraphic abstract. It is an indexing scheme in that it lists actual words or groups of words contained in a document. It is a classification scheme in that it relates the words to each other (in a semi-grammatical way) and to the context as a whole. By indexing words in terms of their functions it makes it possible to search for a given word in a specific context only; for example, one can search for material on achievement tests which are subjected to validation study without retrieving all material on experiments involving the use of achievement tests. It is entirely "open-ended" in that any actual terminology used by an author may be recorded by the indexer without the necessity of revising the scheme. It is extremely flexible in that it permits access to any reference point or any combination of reference points without the necessity of providing visual permutations of these reference points. A full explanation of the telegraphic abstract as developed for educational research materials and examples of its application are given in the manual used for this project (see Appendix B, pp. 163 ff.

4. Terminology Control

In the description of the telegraphic abstract given in the previous section it was explained that any actual word used by the author in a document may be recorded by the indexer. However, actual, uncontrolled vocabulary would be next to impossible to search with any degree of confidence. The chances that a future questioner would hit upon the exact wording of a document, unknown to him, which would be relevant to his query, are remote. Even if he made lists of likely words and asked for documents containing any of them, he would probably still miss some. It would also be virtually impossible for him to search for classes of words from lists of actual, specific terminology. Therefore, as an integral part of the information system, a mechanism has been developed to provide for the searcher the ability to exploit with confidence the terminology of this field either on a specific or on a general level, i.e., to provide him with the possibility of searching for documents referring to one specific word (and for its synonyms), such as one specific method of testing, for example, or documents relating to certain broad concepts or classes of concepts, such as documents relating to any test used to obtain a certain kind of data. The mechanism developed for controlling the terminology contained in the documents of this pilot collection is a semantic code, which makes explicit the thesaural relationships of the terminology and provides for the system the traditional index function of "see" and "see also" references.

In constructing the semantic code for the terminology of educational research, we relied heavily upon previous work in defining terms used in the discipline.

Invaluable to us were such sources as:

Buros, Oscar K., ed., "Classified Index of Tests," Fifth Mental Measurements Yearbook (Highland Park, New Jersey: Gryphon Press, 1959).

Cook, Desmond L., *A Glossary of Teaching Machine Terms* (Lafayette, Indiana: Purdue University, 1960).

Good, Carter V., ed., *Dictionary of Education* (New York: McGraw-Hill, 1959).

Lorge, Irving, *Terminology and Concepts in Appraising the Mentally Retarded* (New York: Columbia University, 1961).

Tauber, Maurice F., and Oliver L. Lilley, "Faceted Classification Schedule," *Feasibility Study Regarding the Establishment of an Educational Research Information Center* (New York: Columbia University School of Library Service, 1960).

Standard Tests, The Bureau of Educational Research and Service, Publication No. 48 (Iowa City, Iowa: State University of Iowa, 1960).

Webster's New International Dictionary, Second Edition, 1955.

Webster's New World Dictionary, College Edition, 1960.

Webster's Third New International Dictionary, Unabridged, 1961.

Another source of definition is, of course, the context of the document itself. In an information service which emphasizes the timeliness of its materials, new words or words used with new specialized meanings will not yet have found their way into even the latest glossaries or dictionaries. Subject specialists also have been most generous in offering their help in defining certain clusters of terminology.

The semantic code can be compared to English words which are made by combining Greek and Latin roots, such as *thermo*, *meter*, *photo*, *phono*, *graph*, *stat*, etc. Words constructed from these roots tend to define and classify themselves.

We can know from the presence of "thermo" and "meter" in "thermometer" that a thermometer has something to do with measurement and with heat. We could also form a class or a set of all those words containing the root "meter:" telemeter, voltmeter, pedometer, hydrometer, etc., and know that they probably have to do with the idea of measurement. Thermometer would belong to both classes or sets.

For a retrieval system a natural language built in this methodical, consistent fashion would be very convenient, because then to search for information on "heat measurement" all we would have to do would be to specify the combination of "thermo" and "meter;" but, unfortunately, the English language is not consistent. We have as many names of things derived from Germanic as from Greek and Latin roots. And some words, such as "striking doll" give an inadequate linguistic clue as to their meaning or conceptual class.

The semantic code, using three-letter units as roots, or factors, which stand for general concepts, makes possible a retrieval system where each term entering the system can be recorded on consistent principles which define the term and relate it to other classes of terminology with which it shares common aspects of meaning. Thus a term such as Osler machine becomes, in the semantic code, "a machine used for teaching by means of a film." As a classification scheme, the semantic code places Osler machine simultaneously in three classes of terminology, those having to do with machines in general, teaching in general, and photography in general. As a thesaurus, the semantic code makes explicit, and therefore available for searching, the relationships among Osler machine and other teaching machines, such as Visitutor. At the same time the full code for Osler machine has a unique tag which identifies it as the code for this term only.

After the term Osler machine has been encoded it can respond to searches for (1) Osler machine, (2) teaching machines using film, (3) teaching machines in general, or even to broad searches for (4) machines, (5) teaching, or (6) photography.

In a search the separate factors or combinations of factors in the semantic code are used as a sort of fish hook to identify and bring up various types of clusters of terminology which relate to the concepts with which a question is concerned.

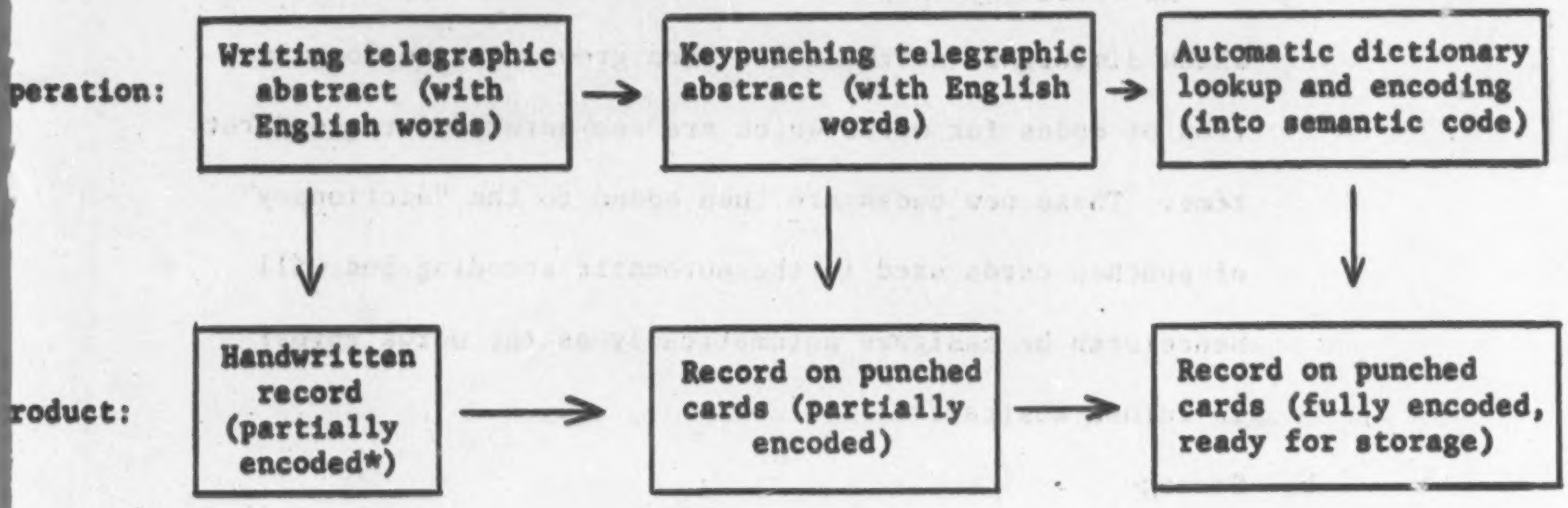
The investigators feel that the semantic-coded approach to terminology control is appropriate for an information system dealing with the growing and shifting vocabulary of educational research.

A full explanation of the semantic code and sample lists of encoded terminology encountered in the pilot collection is given in the Manual for Encoders, Appendix C, Part 1, p. 124.

5. Processing for Input

a. Automatic Encoding

The actual encoding of the natural English words selected and recorded by the indexers in the course of making a telegraphic abstract is performed automatically by use of punched cards and data processing equipment. A simplified flow diagram of this procedure is shown below in Figure 4.1.


peration:
Writing telegraphic abstract (with English words)
Keypunching telegraphic abstract (with English words)
Automatic dictionary lookup and encoding (into semantic code)
roduct:
Handwritten record (partially encoded*)
Record on punched cards (partially encoded)
Record on punched cards (fully encoded, ready for storage)

* For convenience, punctuation and role indicators are recorded by the indexer in the form of their final codes.

Figure 4.1

Simplified flow diagram of the processing of telegraphic abstracts for input to the information system

The automatic encoding procedure itself involves sorting, collating, and reproducing operations. The full procedure is shown in Fig. 4.6, following p. 66. It has been our experience that when the telegraphic abstracts are batched for further processing the steps shown on this diagram accomplish the task quickly and efficiently. Approximately 100 abstracts make up a batch that can easily be processed by one machine operator in approximately four hours.

An ancillary task to the automatic encoding, but one which diminishes as the collection grows, is the formulation of codes for words which are encountered for the first time. These new codes are then added to the "dictionary" of punched cards used in the automatic encoding and will henceforth be assigned automatically as the words appear in future abstracts.

b. Storage

The medium chosen for storage of the encoded telegraphic abstracts of the documents of the pilot collection was magnetic tape. The choice was made because the ability to search the tapes by computer permitted us

(1) to exploit fully and at high speed the flexibility of the indexing system we were developing, and

(2) to simulate and test any other less flexible system, as might prove appropriate during the course of the project.

This choice was made possible because the Center for Documentation and Communication Research owns a GE 225 computer and a program for performing literature searches based on the system of analysis and encoding which was applied to the pilot file.

The transfer of the encoded telegraphic abstract from punched cards as it exists after the automatic encoding operation (see Figure 4.1) to magnetic tape is performed by an automatic card reader, a basic on-line input device used in the GE 225 system, which can read punched cards and write the equivalent information onto magnetic tape. The tapes then become the index to the library of documents. The tape record of the index to each document contains an accession number which automatically prints out during a search whenever a document is identified as an answer to a question. A question is addressed to the computer by keypunching the specifications of the question onto punched cards, feeding them into the card reader which in turn feeds them into the "memory" of the computer where they are held and matched to the tape files as the files are "read" during the search.

Magnetic tapes are a convenient storage for indexes. They occupy very little space. They can be read at exceedingly high speed. The indexes to 100,000 documents contained on 17 reels of tape can be read in approximately four hours. These 100,000 encoded abstracts would contain some 8,000,000 code words. Every identification made during a search slows down the reading speed. However, this factor is compensated for by the fact that up to 100 separate searches can be performed simultaneously.

Tape files can be reproduced wholly or in part to produce other libraries or sub-files. They can be printed out so as to produce a visual record of their contents.

6. Sample Questions

a. Sources

As soon as the first portion of the sample library was encoded and on magnetic tape, ready for searching, we needed questions with which to query and test the system. It would have been possible to conduct a controlled experiment by constructing questions based on the documents of the library and searching the tape files to see if the search identified the documents upon which the question was based. However, the Center for Documentation and Communication is convinced that there are inherent fallacies in this approach. Questions based on texts tend to be syntactic transformations of declarative sentences into interrogative sentences. The substantive words of the text tend either to remain the same in such questions or to be generalized on the "collie-to-dog" level. Real questions on the other hand, almost never mesh in toto with actual sentences in texts on the syntactic level and most always have an uneven and unpredictable specificity-to-generality relationship to the substantive words of the text. Moreover, real questions often can be satisfied only with partial answers from any one document.

For these reasons, the Center wanted real questions with which to test the pilot system. There was also another important reason. Real questions posed by a large and diversified segment of the educational research community would give the project workers insight as to the research needs of the field. If real questions could be obtained early enough in the project, the intelligence gained from them would be invaluable in guiding the entire program in giving us an idea of what topics are currently of interest to educators. They would alert us to types of materials to acquire during the scanning of the literature. They would give us a standard against which we could examine our indexing to determine the adequacy of our analysis and terminology control.

To obtain real questions, the following announcement of the pilot project, soliciting questions, was released for publication.

ANNOUNCEMENT OF A PILOT INFORMATION SERVICE OF EDUCATIONAL RESEARCH MATERIAL

... Are you reading more now and remembering less?

> If you are active or otherwise interested in the field of educational research, you are probably finding it more and more difficult to assure yourself that you are keeping up to date on current developments. If you are at all typical, you are getting somewhat frantic or disgusted or just bored when confronted with the requirement of perusing so much material that is of little interest in order to isolate those items that are desired. And if you are not one of a vanishing minority, you have less time available for perusing and you are doing less of it than you know you should.
>
> If by a wave of a magic wand you could be assured that by proper specification of your interests through a question, a mechanized searching activity could notify you on a current basis of everything that is being published anywhere in the world--would you wish to take advantage of such a facility?
>
> This facility has not yet been created, but the magic wand has been raised by the U. S. Office of Education in supporting the development of a pilot information service of educational research materials at the Center for Documentation and Communication Research of Western Reserve University. The primary purpose of this program is to develop and put into operation on a pilot basis a suitable information retrieval system which will permit the detailed analysis of educational research material and selective dissemination, based on individual interests and requests on a current basis.

The magic wand of a mechanized information retrieval service can be placed in your--the reader's--hand by cooperating with us today in making known how you might specify your interests, through a question or several questions, when such a service is offered to you.

Let me give you some examples of alternate ways in which you might phrase a question and thus provide yourself with broader or narrower selections of the literature:

1. Send me everything published on "concept formation."

2. Send only those materials which discuss "concept formation" in young mentally retarded children.

3. Confine my question to "concept formation" in young, mentally retarded children as an indicator of educability.

The example questions given here become successively more selective, with the third one being quite narrow.

Please send us questions in your fields that represent the subject matter as well as the level of selectivity that might satisfy you in a service that would keep you currently informed of everything going on in areas of educational research of interest to you.

Your questions will be useful to the Center and to the U. S. Office of Education in pre-testing the pilot system on the basis of user requirements. A significant sampling of questions will be searched and the results made available to the sender for evaluation.

Please send your questions to:

Professor Allen Kent, Associate Director
Center for Documentation
and Communication Research
School of Library Science
Western Reserve University
Cleveland 6, Ohio

Also urge your colleagues to send questions, too.

This announcement was sent to leading publications in the field of education, such as the following:

AERA Newsletter

American Psychologist

American School Board Journal

Atlantic Monthly

Audio-Visual Communication Review

Clearing House

Cooperative Research Newsletter

Educational Forum

Educational Leadership

Educational Records Bureau (Newsletter)

Educational Research Bulletin

English Teacher

Exceptional Children

Harpers

Harvard Educational Review

Journal of Educational Psychology

Journal of Educational Research

Journal of Educational Sociology

Journal of Experimental Education

Journal of Teacher Education

Library Resources

Library Trends

Mathematics Teacher

Modern Language Journal

National Association of Secondary School Principals Bulletin

National Education Association Journal

National Elementary Principal

Nation's Schools

NCME Newsletter

Newsweek

Overview

Peabody J. of Education

Phi Delta Kappan

Research (Recreation, Health and Physical Education)

Saturday Review

School Life and Higher Education

School Science and Mathematics

Science

Time

Title VII News and Reports

U. S. News and World Report

In addition, approximately 200 copies of the announcement were given out by the Office of Education. It was also sent to some 6,000 people on the Center's mailing list. These latter people were, of course, not predominately educators. Rather they represented a cross-section of scientists, research management, and librarians from government, industry and academic institutions, many of whom responded with education-directed questions.

From this announcement, the project received 400 questions from 247 questioners covering a wide variety of topics and expressed in a wide variety of generality or specificity. Examples of the range are

Question 1. Use of Word Association Tests with deaf persons (children and adults) for any kind of diagnostic or investigative purpose.

Question 2. Research on electro-chemical phenomena in the brain related to learning and cognitive processes.

Question 3. Educational TV.

Question 4. Current developments in colleges and universities.

The full list of questions is given in Appendix D, page 262.

A tabulation of the professions or affiliations represented by the questioners is given in Table 4.2.

Profession or Affiliation of Questioner	Number of Questioners
College professors including administrators & librarians	75
School administrators	42
Research bureaus	27
School teachers and librarians	21
Business and industry	19
State and national organizations	23
Special training centers including military, correctional, remedial, etc.	12
Boards of education, local school study groups	13
Students	12
Municipal organizations	3
Total	247

Table 4.2

Sources of Pilot Questions

A tabulation of instances of reference to general topics contained in the 400 questions is given in Table 4.3.

Administration	152
Population characteristics	141
Teaching methods	133
Teaching media	86
Testing methods and devices	43
Methodology, statistical methods	6

Table 4.3

General Topics of Pilot Questions

b. Search Strategy and Manipulation

To date 144 of these questions have been analyzed and searched through various portions of the files. Some of the questions have been searched several times over using alternate strategies in order to examine the effect of various approaches to the file on the kind and quantity of answers.

The procedures for conducting a search begin with the same kind of analysis of subject content and encoding of terminology as is used for processing the input documents.

(1) The question is analyzed as to subject content, or "meaning." This analysis yields the reference points which will later be matched to the file. In

a practical sense this question analysis obviously must follow the same rationale as the analysis of the documents.

(2) The question is encoded, i.e., translated into a configuration of (a) role indicators, (b) semantic codes (or appropriate semantic factors whenever it is desirable to identify clusters of vocabulary rather than an individual word) and (c) punctuation. This operation defines the scope and context of answers which will be considered acceptable in the search.

(3) The formulation of search strategy does not have a parallel in the input operations. In formulating a search strategy the system permits the programmer to search for any of three logical requirements. For example, if the letters A and B stand for parts of the question, the question programmer may ask for

A in conjunction with B (symbolized as A·B)

A and/or B (symbolized as A+B)

A but not B (symbolized as A-B)

Search strategies for complex questions are often formulated using all three of these logical devices, so that a seven-part question might be stated as a Boolean polynomial expression as follows:

$$A(B + C) \cdot (D + E + F - G)$$

An example of such a question in natural language could be, "closed-circuit or commercial TV used in teaching French, German or Spanish but not Russian," where A=teaching; B and C=closed-circuit and commercial TV; D, E, F, G = the respective languages.

When this logic is used in conjunction with the semantic factors, role indicators and punctuation, the search formulation can be a flexible and discriminating search tool, permitting searches to be directed toward any point within the entire range of specificity to generality provided for by the system. Moreover, alternate strategies for the same question can be searched simultaneously whenever the nature of the question makes this desirable.

(4) The completed search formulation is fed into the computer where it is matched against the files during the search. To indicate that an answer has been found, the accession numbers of documents which conform to the search requirements are printed or punched out by the computer.

The general approach to search strategy during the pilot project was one of caution. Searches were usually formulated broadly at first and then tightened by degrees to detect at which level they could attain the best ratio of good to bad answers. While the processed file was still small enough to permit it, hand searches were also conducted to determine whether the machine searches were missing relevant documents.

7. Evaluation of Responses

To test the pilot system the responses to questions were evaluated by

a. The project staff

b. The original questioners

c. Faculty members of the Western Reserve University Department of Education.

These three types of evaluation were designed to give us three different insights to the functioning of the system.

The evaluation by the project staff within the Center provided us with raw data which was used to determine where specific changes, improvements and refinements were indicated in searching techniques, in semantic codes, and in selecting and recording reference points in the telegraphic abstracts.

The evaluations by the questioners were used to obtain data on the ability of the system to satisfy individuals by providing materials which they will consider directly pertinent or at least of peripheral interest. The content of the conventional abstracts presented as answers obviously affected the evaluation of the response. Thus we are also able to obtain critical appraisals of the adequacy of the conventional abstracts.

The evaluations by members of the Western Reserve University Department of Education (and by groups of potential users who happened to ask the same question) served to demonstrate that the borderline between direct pertinence and peripheral interest is a shifting one. Two specialists in the same field, asking the same question and receiving the same documents as responses, do not invariably pass the same judgment on the relevance of each individual response. Nor are the ratings of relevance assigned by two evaluators identical when the question represents the prime subject interest of one evaluator but only a secondary or new interest of the other evaluator.

Examples of these three types of evaluation are given below:

a. Evaluation by Project Staff

This evaluation is conducted on raw computer output of search results. It is not aimed at judging the importance or value of answers, but rather at determining the adequacy of the indexing and searching. In considering the adequacy of a search one may envision three sets of documents: (1) the entire file, (2) the retrieved documents, and (3) the relevant documents. A search may result in any of seven different retrieval situations as illustrated in Figure 4.4, p. 57.

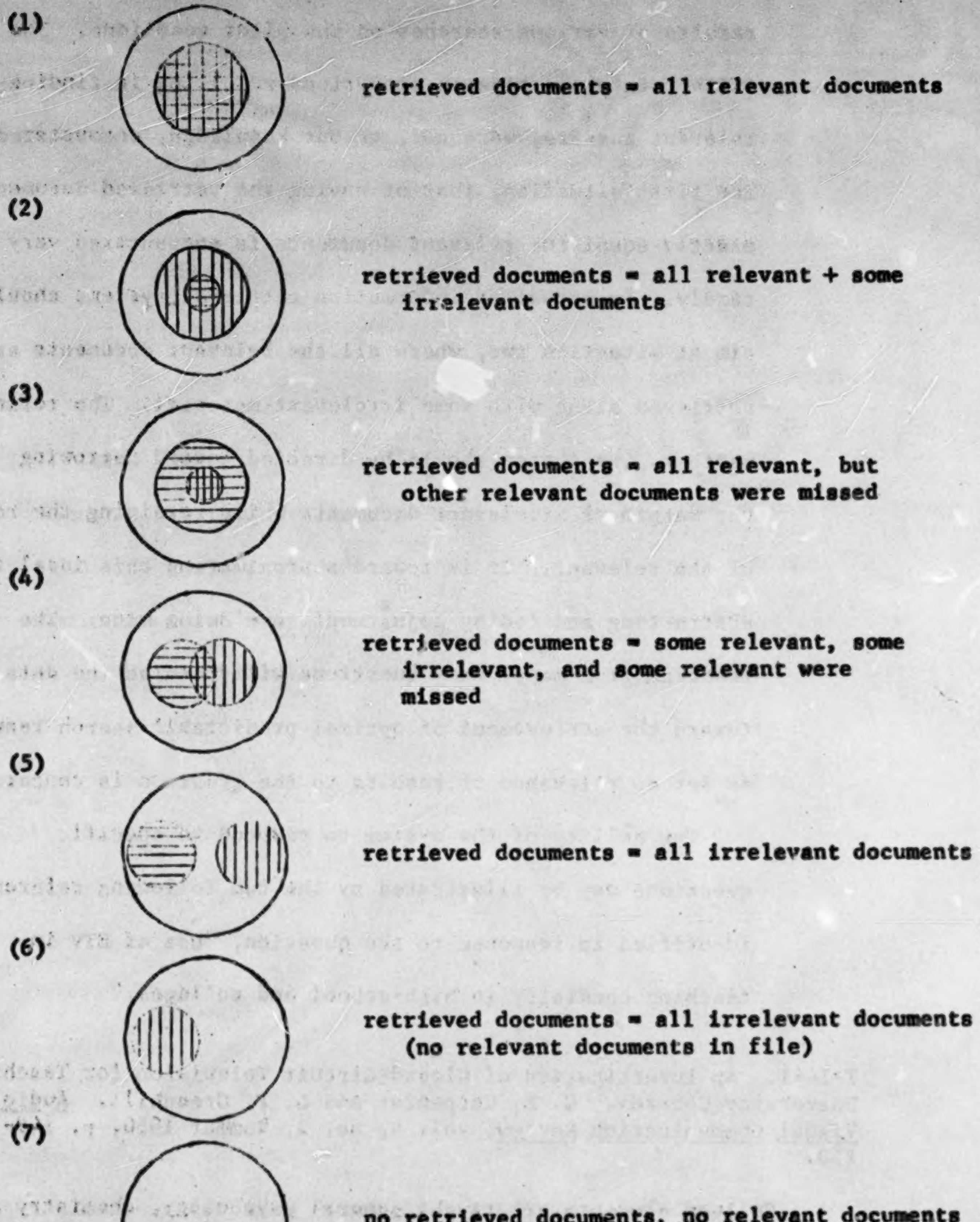

(1)
retrieved documents = all relevant documents
(2)
retrieved documents = all relevant + some irrelevant documents
(3)
retrieved documents = all relevant, but other relevant documents were missed
(4)
retrieved documents = some relevant, some irrelevant, and some relevant were missed
(5)
retrieved documents = all irrelevant documents
(6)
retrieved documents = all irrelevant documents (no relevant documents in file)
(7)
no retrieved documents, no relevant documents

Figure 4.4

Diagrammatic Illustrations of Possible Consequences of a Search

KEY: ○ **= entire file** ▤ **= relevant documents**

▥ **= retrieved documents**

The first four situations have been encountered as the results of various searches on the pilot questions. The fifth, sixth and seventh situations resulting in finding no relevant answers, were not, to our knowledge, encountered. The first situation, that of having the retrieved documents exactly equal the relevant documents is encountered very rarely. In actuality, information retrieval systems should aim at situation two, where all the relevant documents are retrieved along with some irrelevant material. The refinements to the system should be directed toward narrowing the margin of irrelevant documents while retaining the recall of the relevant. It is toward approximating this ideal that abstracting and coding adjustments are being made. The feedback from many, many questions will furnish the data toward the achievement of optimal predictable search results as far as relevance of results to the question is concerned.

The ability of the system to respond to specific questions may be illustrated by the two following references identified in response to the question, "Use of ETV in teaching chemistry in high-school and colleges."

T-1441. An Investigation of Closed-Circuit Television for Teaching University Courses. C. R. Carpenter and L. P. Greenhill. Audio-Visual Communication Review, vol. 4, no. 3, Summer 1956, p. 249-250.

College students are taught general psychology, chemistry and psychology of marriage by CCTV, some in TV studio and some in classroom. Measures of effectiveness and acceptance are made by examination, ratings and attitude scales. Results indicate that learning by television groups is substantially equal to that of regular instruction groups.

T-0746. The Effectiveness of High School Television Correspondence Instruction. Leon Harry Tottmann, University of Nebraska. Dissertation Abstracts, December, 1960.

Study to investigate development of attitudes at different levels of school ability. Classes taught in beginning and advanced algebra, geometry, chemistry and English, physics, mathematics, art and Spanish. Data secured by achievement tests and attitude scale. The differential effectiveness of TV correspondence study instruction is not related to levels of school ability. Students in TV-correspondence instruction achieve as well as those taught by conventional methods but their attitudes are less favorable.

The ability of the system to respond to broad questions can be illustrated by the following abstracts selected from 22 which were identified in response to the question, "Development of efficient thinking processes." (All 22 responses were considered pertinent by the questioner):

S-0207. Effects of Extended Effort in Creative Problem Solving. Sidney J. Parnes. Journal of Educational Psychology, vol. 52, June, 1961, p. 117-122.

Undergraduate students, trained and untrained in use of deferred judgments, are administered the hanger problem from the AC Test of Creative Ability, with variations in time limit. Data are analyzed by a Lindquist Type III analysis of variance. A significant relationship is found between total quantity and total quality of ideas as determined by raters. The findings also suggest that significantly more good ideas appear late in the test period, supporting Gordon's theory of the relationship between deferment and creativity in problem-solving. 14 refs.

T-0145. A Study of Cognitive Development and Performance in Children with Normal and Defective Hearing. Mildred C. Templin. Cooperative Research Monograph, OE-12006. U. S. Office of Education, 1960.

Proposal to study concepts, generalizations, and abstractions as they are formed by children in their everyday experiences and in controlled experimental situations and to trace the development of these abilities. Subjects will be two groups of 60 children each at age levels of six, nine, and twelve. Group one will be made up of children with normal hearing enrolled in public schools, and group two of deaf children in special classes. Each child to be tested for concepts, generalizations, and abstractions attained in language, quantity, form, etc.

T-0691. Teaching High School Students a Critical Approach to Contemporary National Issues. Donald W. Oliver. Research Relating to Children, Clearinghouse for Research in Child Life, U. S. Department of Health, Education, and Welfare, August 1960 - January 1961.

> Some considerations of the possibilities and difficulties of teaching a critical understanding of contemporary political, social, and economic issues in the public schools. Methods and practices include the probing-questioning Socratic approach, special teaching materials and discussion technique. Changes in student's ability to apply principles of critical thinking to be identified through content analysis of written and oral communication.

T-1208. Inductive Concept Formation in Normal and Retarded Subjects, Claude B. Elam, Texas Christian University, Cooperative Research Project No. 833, Cooperative Research Bulletin, No. 18, OE-12004-60, 1961, pp. 10-11.

> Study proposes to explore and delineate the variables which influence concept formation and to compare concept formation in normal and subnormal populations. Three groups (1) normal children (ages 8-14), (2) retarded children (ages 10-18), and (3) college students will be studied in situations of learning and problem solving. Measures of rate of learning and the frequency of errors will be used to differentiate the groups.

b. Evaluation by Questioners

Although the internal investigation of raw computer output of searches indicated how well the pilot system could select documents whose factual content was relevant to questions, only the questioner himself can say how important to him were the references provided as a result of search. Therefore, from the questioner's own evaluation of the references which had been sent in response to his question we were able to gauge to some degree the amount of satisfaction the pilot searches gave to individual questioners. Moreover, we were able to learn much about questioners' needs and desires from their comments both on the general results or on specific abstracts.

The final tabulation of questioner's evaluations indicates that of 1,155 responses sent in reply to 93 questions

62.3% were considered pertinent

23.1% were considered of peripheral interest

14.6% were considered nonpertinent.

Typical comments explaining reasons for considering an answer as either peripheral or nonpertinent are the following which reflected upon

(1) The incompleteness of the abstract sent as a reply,

Example: "Gives plan only, no results. Again, a reasonable miss."

or, "would like to know results."

or, "Description of study too sketchy to evaluate properly."

(2) The analyst's misinterpretation of the intent of the question,

Example: "I wouldn't call a reading pacer a programmed learning machine."

or, "Our study not concerned with background. We desired practical situation measures."

(3) The desire for substantial contributions to the questioner's knowledge,

Example: "Nothing new."

The two latter reasons for rejecting answers would, of course, be alleviated to a large extent by operating experience and by consultation with the questioner when questions are phrased ambiguously or too broadly. The first reason for rejection of an answer, that of the inadequacy of the conventional abstract, can largely be alleviated by adhering

to the rules for writing conventional abstracts as formulated in the Manual given in Appendix B, Part 1.

The capability of the system to respond selectively to searches can be illustrated by examples of responses to two questions: Questioner A asked for material on "the counselling process;" Questioner B asked for material on "group counselling."

The following abstracts were identified in response to both questions:

T-0664. A Comparison of the Relative Effectiveness of Three Types of Counselling When Change in Academic Performance is Used as the Criterion. George L. Marx. Research Relating to Children, Bulletin no. 13, Clearinghouse for Research in Child Life, U. S. Department of Health, Education, and Welfare, Aug. 1960-Jan. 1961, p. 42.

Proposal to evaluate general effectiveness of counselling on academic achievement; to analyze the comparative effectiveness of three different approaches to achievement counselling--individual counselling, group counselling, and group counselling followed by individual sessions; to identify personality variables associated with enhanced academic achievement as a result of counselling. Underachieving tenth grade pupils from five Baltimore County senior high schools are randomly assigned to the three groups.

S-0109. Sister Mary Viterbo McCarthy. The Effectiveness of a Modified Counselling Procedure in Promoting Learning Among Bright Underachieving Adolescents. Cooperative Research Project no. 0052 (SAE 6401), Regis College, Weston 93, Massachusetts, no date, 39 pp.

Two small experimental groups of ninth grade boys participate in group discussions based on simulated case histories of underachievers and moderated, but not directed, by counsellor. Case histories developed from boys' responses to Biographical Inventory, Kuder Preference Record and California Test of Personality. Comparison with control groups shows no improvement in school achievement or attitude within the time limits of the study. Ego-defensiveness in group discussions indicates usefulness of supplementary individual meetings with counsellor.

(Abstract T-0664 was evaluated as pertinent by both questioners. Abstract S-0109 was evaluated by Questioner A as pertinent to his question on the counselling process, but was evaluated by Questioner B as peripheral to his question on group counselling.)

The following abstract was identified in response to the more general question, "the counselling process," only.

T-0235. Influence of Sex of Counsellor and Client on Client Expressions of Feeling During Counselling. Francis Fallon Fuller, University of Texas. Dissertation Abstracts, March, 1961.

> Investigation of hypotheses regarding the influence of sex and experience of counsellor, and sex of client, on expression of feeling by client. University students with nonpersonal problems are interviewed by four men and four women counsellors, two experienced in each sex-group. Clients' statements, taken from tape recordings and case notes, are scored by a modified Kelly and Fiske Relationship Index. Female clients are found to express more feeling than male. Both sexes express more feeling in presence of female counsellors. Experience of counsellor is found to have no influence on amount of feeling expressed.

c. Evaluation by Western Reserve University, Department of Education.

A comparison of multiple evaluations of identical sets of answers to the same question has provided graphic indication of the effect of different orientations and approaches to a question on judgment as to pertinence of answers. Several sets of answers for which we received evaluations from questioners were given a second evaluation by members of the Western Reserve University Department of Education. (Other sets of responses also were evaluated by more than one person since in some instances two or more questioners asked identical questions.) Results of some of the multiple evaluations are presented below in Table 4.5.

Question	Number of Evaluations	Number of Answers	Percent Total Agreement
Reading Ability	3	30	20.0
Research on Educational Testing	3	32	15.6
Class Size and Teaching Effectiveness	2	4	50.0
The Slow Learner	2	8	37.5
Teaching of the Mentally Retarded	2	17	58.8
Team Teaching	4	23	52.2
Teaching Machines and Programmed Instruction	7	40	72.5

Average Total Agreement: 43.8 Percent

Table 4.5

Multiple Evaluation of Identical Responses

Analysis of the findings presented above can lead to the conclusion that the amount of agreement between educators as to the pertinency of material to a given area of interest may vary greatly. On the basis of these findings, it seems highly unlikely that any sizeable set of answers to any given question would be evaluated in the same way by two or more people interested in the question.

However, this apparent whimsicality of questioners in evaluating responses is deceptive. There are important factors for consideration in correctly interpreting these data. One factor is that the original questioners asked for material to fulfill needs, whereas the Western Reserve University faculty members made a second evaluation as a control check, not because they wanted the material for any personal purpose. Another factor is that two questioners asking the identical question may not be expressing identical needs and thus would not be equally satisfied with identical responses. A third factor is that these questions were expressed rather generally, whereas the unstated, real questions may have been more specific.

The primary value of the findings in Table 4.5 is that they indicate the necessity for the system to know what the questioner wants when he asks a question. This rapport can be established, even in a centrally operated system, by educating and aiding questioners in stating questions in a way which will express their requirements. This education and aid may be given in various ways, such as the following:

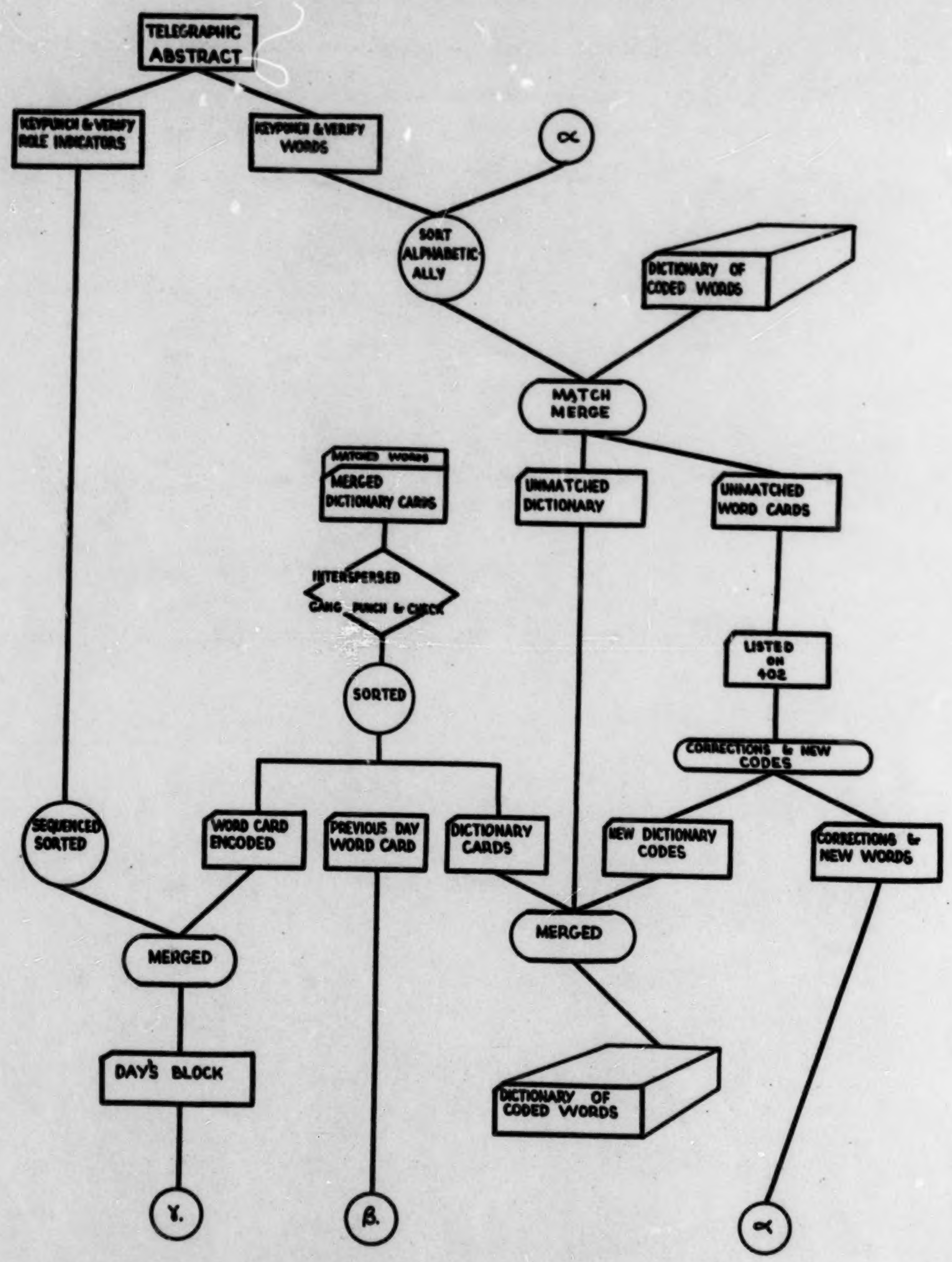
(1) the questioner may be given a general format in which to ask his question which will encourage him to be as specific as possible and to provide examples, if he chooses, of the sort of material he desires.

(2) the question analyst may discuss the question with the questioner prior to programming the search.

(3) the question analyst may provide the questioner with a representative sample of responses, so that the question may be reprogrammed in the light of

the questioner's evaluations.

An information service which can provide truly selective identification of material must, of course, work toward enabling questioners to take full advantage of this capability.


TELEGRAPHIC ABSTRACT
KEYPUNCH & VERIFY ROLE INDICATORS
KEYPUNCH & VERIFY WORDS
∝
SORT ALPHABETIC-ALLY
DICTIONARY OF CODED WORDS
MATCH MERGE
MATCHED WORDS
MERGED DICTIONARY CARDS
UNMATCHED DICTIONARY
UNMATCHED WORD CARDS
INTERSPERSED GANG PUNCH & CHECK
LISTED ON 402
SORTED
CORRECTIONS & NEW CODES
SEQUENCED SORTED
WORD CARD ENCODED
PREVIOUS DAY WORD CARD
DICTIONARY CARDS
NEW DICTIONARY CODES
CORRECTIONS & NEW WORDS
MERGED
MERGED
DAY'S BLOCK
DICTIONARY OF CODED WORDS
γ.
β.
∝

AUTOMATIC ENCODING

Figure 4.6

CHAPTER FIVE

COMPARISON WITH OTHER SYSTEMS

A. Philosophy of Comparison

All systems of information retrieval share certain aspects in common, regardless of the differences in method and philosophy which they may otherwise display. These aspects are the unit operations of literature searching and they are listed in detail below.* But interwoven with the separate criteria for each of the unit operations are two aspects which become overriding considerations in every part of the system. These are:

1. Identification of the needs of the user, including
   a. scope of user interest, and
   b. depth of user interest.
2. Establishment of flexibility, in order to reflect, as soon as they can be identified, changes in
   a. the needs of the user, and
   b. the character of the material, either in content or in terminology.

The unit operations common to all systems, and on the basis of which they may be compared, include:

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* For a review of the terminology of information retrieval and for definitions of individual terms used in this chapter, see Glossary, Appendix F, p. 312 ff.

TABLE 5.1

COMPARATIVE SYSTEMS STUDY

Unit Operation	KWIC	Subject Headings and Descriptors	Uniterms	Classification Schemes	Telegraphic Abstract-Semantic Factor Approach	Auto-Abstracting
I. Acquisition	← Common to all systems →					
II. Analysis (Depth)	Usually limited by number of "key" words in title of document	Economically limited to several (usually quite generic) words or ideas for each document	Usually limited to selection of key words from title and text of document (number chosen usually limited in order to control false association during search)	Monodimensional Classification: only one entry per document Multidimensional Classification: usually limited to several entries	Number of entries generally 10-20 times as many as other systems, since indication of relationships controls false associations during search and costs of recording entries are lower	Sentences are selected from text as based on frequency of occurrence of "key" words
III. Terminology Control	Usually absent during input (Control burden is placed on searcher)	Control fixed by "authority" pre-established	Same as KWIC (which see)	Control fixed by "logic" of the classification system	Semantic code which is superimposed on telegraphic abstract provides control of synonyms, and words with elements of meaning overlapping	↑
IV. Recording of Results of Analysis on Searchable Medium	Various media, but usually in tabulated form, in alphabetic order of key words	Various media, but usually in printed form, in alphabetic order of headings or descriptors	Various media, but usually on cards with each card (for each uniterm) containing record of document numbers to which they apply	Various media, but document numbers arranged under the appropriate headings	Usually on magnetic tape	
V. Storage of Source Documents	← Usually common to all systems →					Not applicable, since this does not produce a search-ready product
VI. Question Analysis and Development of Search Strategy	← Usually common to all systems, except that "depth" of search strategy must match depth of analysis in order to exploit system optimally →					
VII. Conducting of Search	By human scanning of alphabetic arrangement of entries		By matching document numbers on appropriate uniterm cards	By human scanning of classification system	By use of computer to conduct scanning operations	
VIII. Delivery of Results of Search	← Usually common to all systems →					↓

1. Identification and evaluation of sources of material. Once criteria for this operation are established, it becomes the basis for the next:
2. Acquisition of material,
    a. first, on a representative basis, and
    b. second, on a comprehensive basis.
3. Analysis of material in an objective and systematic way to the greatest depth predictable from the forecast of user needs, in order to establish:
    a. rules for analysis that can be consistently applied, and
    b. rules for searching based on the assurance of consistent analysis.
4. Terminological control, in order to regularize the way in which concepts and their relationships are expressed in the literature.
5. Searching of the files in order to exploit to the greatest extent whatever discriminatory sophistication has been built into the analytical procedure.
6. Dissemination of search results in a way that is consistent with the needs of the user and with the responsibility of the operator of the system to the authority which has given him the mandate for its operation.

Each of these unit operations must be carefully and individually considered in the establishment and evaluation of systems of literature searching. The repertoire of mechanisms available is suggested by the tabulation of comparative systems in Table 5.1. The extent to which the operator of a system gains control over these operations directly influences the extent to which his activity responds to the challenge of modern communications as tools for research--and the extent to which he achieves the goal of library service in depth which it is his responsibility to provide.

A system of literature search in which the operator has no control over some of the unit operations--specifically the analysis of material and the control of terminology--can be illustrated by a study of the conventional utilization of already existing library tools to identify the literature.

B. Conventional and Non-Conventional Systems

It has been truly said that "The educational research worker who is unfamiliar with the investigations of others on his problem cannot really know what his own findings mean." (Carter Alexander and Arvid J. Burke, How to Locate Educational Information and Data, 4th ed., rev., New York: 1958, p. 369.) In order to make the results of research generally available, librarians and others have over the years developed a number of systems for the retrieval of relevant research reports. Alexander and Burke's summary of conventional methods is the classic review (cf. Encyclopedia of Educational Research, 3rd ed., New York: 1960, p. 143.), but even they, in their discussion of educational researches, admit that "locating all the important pertinent researches on a problem is one of the most difficult undertakings in library searching." (Alexander and Burke, op. cit., p. 370.) After listing the usual bibliographic tools, such as the Encyclopedia of Educational Research, Dictionary of Education, Review of Educational Research, summaries of doctoral dissertations and master's theses, abstract compilations of various sorts, etc., they conclude:

> No combination of the foregoing lists and procedures can be guaranteed to turn up all summaries. But use of them is likely to produce results superior to those the worker could achieve alone and using far more time.
> (Ibid., p. 371.)

In other words, such instruments are only somewhat better than nothing.

Tauber and Lilley documented these observations in their exhaustive survey of conventional tools (Maurice F. Tauber and Oliver L. Lilley, Feasibility Study Regarding the Establishment of an Educational Media Research Information Service, New York, 1960, prepared under U. S. Office of Education, DHEW, Contract SAE-8328). The Tauber-Lilley study is summarized in Chapter Two of this Report. Its "Summary and Conclusions" (Ibid., pp. 40-44) stand as an impartial review of "existing bibliographical controls" and their exploitation by manual search. The conclusions of Tauber and Lilley that current bibliographies do not satisfactorily represent the new educational media may be taken as definitive. They comment on the need for adequate analysis and terminological control. An improved information service must, together with other desiderata, "provide subject access for topical searches, whether current or retrospective, by means of appropriate devices for subject control of the area." The provision of subject headings and classification tables intended to satisfy this need occupies the largest part, in bulk, of their report.

Certain other considerations not explicitly expressed in the Tauber-Lilley study should be pointed out:

1.. Since the Tauber-Lilley search was directed toward retrieving citations of previously identified, "recognizable" documents, the searchers could utilize any access to the entries of any individual bibliography which they examined. Any kind of index, either title or author, for example, would serve to reveal the presence of one of the wanted documents in the bibliography being searched. It was not necessary to depend, in this kind of search for specific titles by specific authors, on the subject-heading arrangements by which, in many of the sources, the citations were displayed--subject headings which, in most cases, were inadequate.

2. Since the Tauber-Lilley study was not intended to simulate actual searches, but rather to check the coverage of various bibliographical instruments, other criteria for search efficiency were not applied. These criteria include:
    a. the time necessary to perform a thorough search;
    b. the effort involved in such a search;
    c. the expense committed to such a search.

These criteria, as translated in terms of real time, man-hours and effective utilization of personnel and funds, assume a further importance and serve to reenforce the criticisms which Tauber and Lilley explicitly make of the coverage of current bibliographic controls and of the type of analysis which they represent.

This criticism may logically be extended to any system in which the operator lacks complete control over every unit operation. Conventional methodology, failing to provide control over the analysis and the terminological labelling of material, is thus implicitly condemned by Tauber and Lilley and the other sources noted so far.

C. Standardized Abstracts and Classification: General

1. The basis of comparison.

Two systems of literature searching have been established in the course of this Pilot Program.* The first of these is the standardized, computer-oriented, abstracting procedure described in detail in various other portions of this Report. The second is a classified schedule of subjects, developed for specific application in this particular project. The reasons for setting up these alternate systems include:

a. The evaluation of the standardized abstracting procedure on the basis of comparison with another, more conventional method.

b. The need to learn whether the operation of a classification system would provide insight into the problems of terminological control. e.g., the making of semantic codes, and, to some extent, the interpretation of user requests.

2. The standardized abstracting procedure.

The routines set up to carry out the standardized abstracting procedure in the Pilot Program may be summarized for the purpose of later comparison:

a. Preparation of conventional abstracts**for reference purposes and for delivery as the product of machine search.

---

* Three systems have in fact been established. The third is the searching of a file by title only, the possibility for which has been provided by the recording, in the telegraphic abstract, of the significant words of the title. These are designated by a "role indicator" (KTTL) and separated by a "punctuation" barrier from the rest of the telegraphic abstract. This system is not discussed in this section since time has not permitted its exploitation in any controlled fashion. Such experimentation remains as an interesting subject for further comparative study. It establishes parameters by means of which KWIC (key word in context) and other permutation systems based on the words of the title may be evaluated.

** See Glossary, Appendix F.

b. Preparation of telegraphic abstracts* as an index of searchable terms based on the terminology of the document.

c. Use of a Semantic Code* to provide thesaural links by which terminology can be controlled.

d. Recording of the coded telegraphic "index" on magnetic tape.

e. Division of files (or, when necessary, correcting or updating of files) by copying tapes.

f. Use of a computer* for searching.

3. Classification procedure.

a. Sources

A review of the field indicated that no existing schedule of classification was entirely suitable for the subject matter of the Pilot Project. The original intention was to test the media classification system of Tauber and Lilley, (1) using it as the mechanism of analysis for a selected body of documents also analyzed by the standardized abstract system; and (2) using it as the retrieval mechanism in searching that file.

This turned out to be unfeasible in application to the material collected for the Pilot Project, after the arbitrary decision was made to group literature on media with the general literature in the file. While the scheme of Tauber and Lilley, in comparison with other classification schemes, was more than adequate in orientation, it presented certain problems. It is, of course, beautifully detailed in its delineation of media areas of interest.

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* See Glossary, Appendix F.

The psychological and administrative aspect of education, on the other hand, are not given major consideration, and in a file containing documents on general research, these "facets" must be developed.

For these reasons, the classification as finally developed for the Pilot Project is modelled on the Tauber-Lilley scheme, particularly in its "faceted" approach, but differs from it in many details and, often, in emphasis. Other sources consulted include:

Brown, Stanley B., Mary Louise Lyda and Carter V. Good, eds. Research Studies in Education, A Subject Index. Bloomington, Indiana. (Continues earlier Phi Delta Kappa-sponsored series.)

Center for Programed Instruction, Inc. (Schedules.)

Denum, Donald D. A System of Data Banking and Retrieval for Educational Research. Unpublished dissertation. Austin, Texas: 1960.

Dewey System of Library Classification.

Ely, Donald P. "Tentative Terminology Data." Audiovisual Center, Syracuse University. 1962. (Report under Technological Development Project of the NEA, Title VII, NDEA .) (Includes terminology extracted from 10 A/V sources not separately listed here.)

Encyclopedia of Educational Research. Chester W. Harris, ed., 2nd edition. New York: 1960. (List of articles.)

Library of Congress System of Library Classification.

NAEB Research Fact Sheets. Indexes.

National Education Association of the United States. Research Division. "List of Folders in Bibliography and Reference Files." Washington, D. C.: 1960.

Nostrand, Howard Lee. "Bibliography of Research on Language Teaching." Department of Romance Languages and Literature, University of Washington. 1960, 1961. (Bibliography headings.)

Sears, Minnie E. Sears List of Subject Headings. 6th edition, revised and enlarged by Bertha M. Frick. New York: 1960.

Terauds, Anita, Irwin Altman and Joseph E. McGrath. A Bibliography of Small Group Research. AFOSR-TN 60-365. Arlington, Virginia: 1960. (Annotations and Major Variables appear as AFOSR-TN 60-1208 and 60-1207, respectively.)

University Council for Educational Administration. Classification Scheme.

U. S. Naval Training Device Center. "Bibliography of Human Engineering Reports." NAVEXOS P-1491. Port Washington, L. I., New York, 1961.

Wigmore, Shirley. "Preliminary Subject Heading List for NACER" Revised by Gertrude Boyle. Department of Educational Research, Ontatio College of Education. 1958, 1959. (Useful for administrative facet.)

In addition, a score of standard indexes such as the Applied Science and Technology Index, Education Index, Index Medicus, Readers Guide, and various current and former publications of the U. S. Office of Education, including School Life and Price List 31 were scanned to check the emphasis and vocabulary of their index or subject entries as correctives to specialized a viewpoint in the construction of the schedule.

b. The faceted approach.

The five facets* of the classification schedule as finally developed were Population, Media, Teaching, Administration, and Research Design. These were divided into main subcategories as follows:

Population (P)

- Family Characteristics (PF)
- Age Characteristics (PA)

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* See Glossary, Appendix F.

Instructional Locale (PL)
Psychological and Physical Characteristics (PP)
Non-Student Role Characteristics (PN)

Media (M)

Television (MT)
Motion Pictures (MM)
Radio (MR)
Sound Recordings (MS)
Projected Motionless Visual Images (MP)
Non-Projected Visual Images (MV)
Direct Aural, Visual or Tactile Experience (MD)
Teaching Machines (MA)

Teaching (T)

Subject of Education (TS)
Subjects of Teacher Education (TE)

Administration (A)

School or school system, general (AS)
Teacher Personnel (AT)
Pupil Personnel (AP)
Administration in Relation to Environment (AE)
Curriculum Administration and Development (AC)

Research Design (RD)

For the complete classification, see Appendix E, Part 1.

c. Methodology.

1) Code notations recording the major emphasis of a document were assigned by an editor. (For experimental purposes, the assignment was made by a graduate student in the Department of Education, Western Reserve University, so that the analysis would be truly independent of a knowledge of the standardized-abstracts system of retrieval.) Although no limit was set on the number of codes necessary to record major emphasis, four to eight appeared to be the useful range.

2) Coded notation may be recorded in two ways:

a) In a separate "sentence" or section of the telegraphic abstract, set off by appropriate punctuation and preceded by a role indicator (KSH).

Example:

> A study of students in a parochial high school biology class, in which the effectiveness of a series of sound film is measured and correlated with intelligence as a variable.

...KSH,	PLCO	(Church-operated school)
	PLSH	(Senior high)
	PPHI	(High intelligence)
	PPLO	(Low intelligence)
	MMSO	(Sound film
	TSSB	(Sciences, biological)

b) At the end of the conventional abstract, to make the headings accessible to visual search.

3) Detailed notes for the application of the classified codes follow the complete schedule in Appendix E, together with examples of their use.

d. Scope of experiment.

Coded headings were assigned to a subfile of 700 documents. Search strategies utilizing the codes were prepared for representative questions for which evaluated computer search results based on the standardized TA system were available.

4. Factors compared.

In the following sections, the standardized abstracting procedure developed for this project is compared with the system of classified heading analysis utilized for information retrieval, on the basis of data gathered during the experimental study. The comparison is based on only three of the unit operations listed in A., above, since, for all practical purposes, the unit operations of the evaluation and acquisition of material (A1 and A2) and dissemination of search results (A6) are the same for two systems operated by the same authority. Thus the comparison centers around the following operations:

a. Depth of analysis

b. Amount of terminological control

c. Manipulative possibilities

To these a fourth consideration outside the mechanism of unit operations may be added, namely

d. Costs

D. Standardized Abstracts and Classification: Comparison

1. Depth of analysis.

The comparison in this and the following sections is based on five documents, for which complete telegraphic and conventional abstracts will be found in Appendix E. Terms selected for telegraphic analysis are listed in left-hand columns; coded terms assigned to each are listed in right-hand columns.

T-0719

Telegraphic Abstract Terms	Classification Codes
child	RDEX - experiment
emotional	PEMA - maladjustment
disturbed	APMP - psychiatric service
age (7-12)	PLSP - primary grade
elementary school	PLSI - intermediate grade
parent (family)	
diagnosing	
screening	
psychologist	
parental	

permission
referral
social
caseworking
social worker
education
special
class
research
in progress
Judge Baker GC
New England PHCC
Newton, Mass.
rehabilitation
special
therapeutic
class

T-0738

Telegraphic Abstract Terms	Classification Codes
research	RDSU - statistical survey
Indiana U.	PLSJ - junior high
visual aid	PLSH - senior high
industrial arts	TSIA - industrial and applied arts
Muncie, Ind.	
teacher (22)	MM-- - motion picture
investigating	MD-- - direct experience
questionnaire	
number	
type	
utilization	
availability	

T-0739

Telegraphic Abstract Terms	Classification Codes
pupil	RDEX - experiment
above	MT-- - TV
average	PLSI - intermediate grade
elementary school (6 & 7)	TSAM - mathematics
instruction	TSSB - biological sciences
television	
biology	
mathematics	
testing	
achievement	
test	
statistical	
analysis	
(continued)	

comparison
research
Cincinnati, Ohio
1959
biology
learning
testing
TV
ability
mathematics
learning
ability
TV
inservice
experience
teacher

T-0763

Telegraphic Abstract Terms	Classification Codes
underachiever	RDRE - report
Oakland California	PLSJ - junior high
high school	PLSH - senior high
instruction	PEAC - underachiever
reading	TSRC - remedial teaching
workshop	TSRD - reading
elementary school	TSAM - arithmetic
high school	
testing	
stanford	
arithmetic	
report	
developmental	
reading	
high school	
arithmetic	
remedial	

T-0946

Telegraphic Abstract Terms	Classification Codes
intellectual	RDSU - statistical survey
personality	PLUG - undergraduate college
change	PE-- - emotional characteristics
student	PI-- - ability characteristics
college	
measuring	
cooperative scat (cooperative school & college ability test)	
(continued)	

personal
judgment
scale
dissertation
survey
U of Texas
1961
student
college
arts
science
education
business
administration
U of Texas
testing (1955)
cooperative scat
personal
judgment
scale
retesting (1959)
college
perseverance
scholastic
ability
initial

The most apparent evidence in favor of the telegraphic abstract is perhaps not entirely fair: the quantitative evidence of the long columns on the left and the short columns on the right.

A more meaningful, qualitative comparison may be made by examining the kind of categorizing that is apparent in the two columns above. If one extrapolates the evidence of this meager sample from five to--say--50,000 documents, it is easy to imagine the number of times that

PACY	(young children)
APGC	(guidance, counselling)

might appear together.

It is a truism of documentation--although one that is often overlooked--that to increase the size of the file without varying the scope of material contained in the file, is to risk using the same headings again and again until, in effect, the classification scheme is rendered useless. Hundreds of documents "fall out" at every request for information.

The alternative to this situation is a fragmentation of the classification scheme. New distinctions are specified and new tags are authorized. "Young children" in the above example might be divided up by specific ages--4, 5, 6, 7 years, etc. The difficulties here are manifold. Some will be discussed below, under terminological control. Others are:

a. the increasing difficulty of assigning this type of heading from a more complex schedule in any constant way, and

b. the practical difficulties of renovating the file of material already classified under the "old," insufficiently differentiated headings.

In any of the growing, dynamic areas of the social sciences, such a dilemma is unthinkable.

The following table (Table 5.2) shows the levels of analysis available by means of current standard and nonstandard systems.

The system developed for this project, as has been explained elsewhere, involves the almost free selection of index terms from the document itself. There is no limit, stated or unstated, on which they may be expressed. (Editorial control is exercised only in the interest of consistency, completeness, and accuracy.) The depth of analysis attainable in practice is, therefore, optimal. The benefits of this "deep analysis" of the subject matter are exhibited in the results of search.

Table 5.2. Levels of Analysis

A.	Broad, general classes, as areas of technology, materials, processes, populations, administrative or instructional conditions, uses and applications, countries, costs, etc.	
B.	Subclasses or groups, as designated by decimal system, thesaurus, etc.	Retrieval: Manual up to Computer
C.	Associative groupings, as generated by the logic of the document via faceting, telegraphic abstracting, descriptor assignment, etc., or by the logic of the search strategy	Storage: Manual up to Computer
	1. Conjunctive relationships* a. Single aspect b. Logical product c. Logical difference	See Tables 5.3. and 5.4.
	2. Disjunctive relationships* a. Logical sum b. Logical product of logical sums c. Logical difference of logical sums	

*See Glossary, Appendix F.

2. Amount of terminological control.

There are basically three ways in which librarians or others who tag information for later retrieval may solve the problem of terminological control.

a. The first of these is by not controlling it at all. This technique produces the "pure"index. If the words in the left-hand columns on pages 79 to 82, selected as entries for telegraphic abstracts, were to be permanently recorded as unrelated terms, they would probably first be accorded the courtesy of alphabetization. From that point on, and for all purposes of retrieval, their selection as points of search would depend on the designer of the search. In other words, if he thought only to specify "welfare worker," the concept recorded under "social worker" would be lost. If he asked for "arithmetic," "mathematics" would be lost. It is this difficulty which, more than any other (except, perhaps, insufficient depth of analysis) makes conventional searching of indexes tedious and inefficient. Some mechanism must be provided to match the language of the question to the language of the file.

b. The second means of terminological control is that supplied by an authority list.

The classification experiment indicates a simple but often effective way to display relationships: by means of a more-or-less hierarchal schedule which will lead the eye through related categories within each major facet. Interest in a parochial environment refers the searcher to the "Instructional Locale" section of the "Population" facet; there he will find FLCO, "Church-operated school." Handicapped by the generic nature of its vocabulary, the classification schedule still stands as a primitive control of terminology of the several separate headings.

In the standardized-abstracts system, there is no authorized list of "good" words.

c. The third means of controlling terminology is by the establishment of thesaural authority. The application of the thesaural approach by means of the Semantic Code is discussed in Section of this report, and examples are given in Appendix C. A few general statements will suffice here.

A thesaurus is a word-list prepared to show relationships by grouping together words which share the same generic factors. A thesaural group thus becomes an idea-cluster, with the common concept, in each group, serving as the categorizing term. Thus testing and analysis would fall together in a thesaural display, although the English terms used to "define" them do not resemble each other.

The Semantic Code Dictionary, by means of which every word selected for entry in a telegraphic abstract is automatically encoded before it is recorded on tape, establishes and guarantees the thesaural relationship. Thus, to a considerable extent, there is a predetermined relevancy "built in" to the expression of any question in coded terms, and to the response which such a coded question calls forth. In the more conventional terms of the indexer, "see" and "see also" references are automatically provided. (They are visible as well, to the formulator of search strategy, through the display of the Code-to-Word Dictionary, listings of which are made available periodically through a programmed computer routine.)

The use of the Semantic Code in this Pilot Project has involved the building of a thesaural Semantic Code Dictionary literally generated by the terminology of the telegraphic abstracts now on tape. It is tailored to order to the needs of the social sciences, and specifically designed to control their notorious "soft" terminology, which has until now effectively blocked the establishment of library service at a useful depth. The possibility of further investigation of the use of an "intermediate" subject-authority list, to achieve a more nearly complete terminological control, is mentioned in Chapter Seven, Section B, Part 2, page 106.

3. Manipulative Possibilities.

To the eye of the outsider, the manipulation of the file in the search process is a separate and discrete operation. This is the reason that so much attention is paid to gadetry and hardware, and this is the secret of the success of the salesman who sells backwards, so to speak, by implying that the whole system of unit operations comes ready-made along with the magic box.

In any practical sense there is little to choose between various non-conventional systems insofar as mechanization--or automation--is concerned. Anything more sophisticated than call numbers or an alphabetical array of titles is amenable to the mechanical routines of sorting and collating equipment. Both of the systems discussed here, standardized abstracts and classification schemes, can be adapted to computer applications. Even for the rather simple matching involved in searches based on reference to classified schedules, the computer has for large-scale operations unparalleled advantages of speed and accuracy. For the more elaborate correlations possible with the system of coded telegraphic abstracts, the computer is a sine qua non.

The following tables (Tables 5.3 and 5.4) show the manipulative possibilities available with several available systems and machines.

More important than the device, however, is the broad view of systems analysis which the rival procedures demand. The decision as to what manipulative device is most useful depends on the decisions made all along the line. What is the optimum depth of subject analysis? What is the needed amount of terminological control? Once these questions are decided, the choice of searching device becomes merely a matter of shopping. But it is shopping that has become purposeful and informed--shopping for the means to a carefully considered end.

It remains only to be pointed out that the possibilities for correlation, in the coded terms of the telegraphic abstracts listed above, are all but endless. The advantages of the classification approach are--most important, perhaps--its neat and conventional aspect, and its convenience in application for broad searches of small files. These advantages fade away, as already indicated, in direct proportion to the size of the file; as measured not merely in numbers of items on file, but mainly in terms of the increasing complexity and interdisciplinarity of the subject matter.

Examples may serve to illustrate these summary statements. One of the questions run against the subfile of 700 documents doubly analyzed by both encoded telegraphic abstracts and class codes was this:

Table 5.3. Systems in Use

	Designation	Machine	Relationships
A.	Dewey Decimal, U.D.C. Library of Congress, etc.	Manual to sorter	Conjunctive
B.	Classification, authority lists, descriptors, etc.	Manual, edge-notched cards, etc., up to computer	Disjunctive and Conjunctive
C.	Natural text	Computer	
D.	Key word in context	Manual up to computer	Conjunctive
E.	Standardized abstracts	Computer	Disjunctive or Conjunctive

Table 5.4. Machines for Logical Analysis

		Aspect Cards		Tabulating Type of Punched Cards		
	Marginal Hole Punch Cards	Number-Posted for Visual Inspection	Peek-a-boo	Document System	Aspect System	Standardized Abstracts System
Single Aspect	x	x	x	x	x	x
Logical Sum	x	x	x	x	x	x
Logical Product	x	x	x	x	x	x
Logical Product of Logical Sums	x	x	x	x	x	x
Logical Difference	x	x	x	x	x	x
Sequence	-	-	-	-	-	x
Between Barriers	-	-	-	-	-	x
Greater Than, Less Than	±	±	±	±	±	±

Q1. Programs for high-ability high-school students in science. The computer response to the rather broad coded question based on the abstract system developed for this Pilot Project gave 11 answers which the questioner regarded as pertinent, and 2 which he rejected as not containing enough information. The classification approach to the same file yielded 6 pertinent answers and none that were non-pertinent. Obviously, five documents were entirely missed by the latter approach. A subseqest manual search of the file of 700 documents indicated that the machine search had missed no pertinent documents.

Q2. Branching experiments in programmed instruction. The computer response to the rather specific coded question based on the standardized-abstract system gave seven pertinent answers, and one which was rejected as non-pertinent. The classification approach to the same file yielded seven pertinent answers, all of which required checking against the original document since there was no available analysis comparable to the telegraphic abstract by means of which they could be evaluated. Further, the classification approach yielded 69 other, non-pertinent answers, and these also were identified only by recourse to the original document. The difference in time and cost between the two types of search becomes clear, especially when the cost of the final step of research--evaluation--is taken into account.

It is evident from this summary review of analytic, terminological, and manipulative procedures that, at this point, at least, neither man nor machine is victorious. Certainly human abilities, eith alone or with the help of conventional searching tools, cannot cope with the tremendous amount of literature generated by the live and ever-growing area of creative thought which is educational research. Just as certainly, the sensitive and vital control centers of any information system cannot at this point be surrendered to machines, regardless of their capabilities or their cost. The goal of the responsible operator of any information system, at this stage of modern technology, is the careful supervision and thoughtful control of every unit operation in what is finally an interaction of man and machine.

CHAPTER SIX

COSTS OF OPERATIONAL SYSTEMS

A. Proportionate Expenses of Operational Systems

Experience in bringing other projects from an experimental to a pilot status, and then to an operational status, enables the Center to make certain generalizations which may be helpful in two ways:

1. the approximation of a cost schedule, for budgetary purposes; and
2. the evaluation of any unit figures which may be submitted, in terms of a realistic norm.

A comparison of the schedule of expenses laid out here with the the cost of operating any other system is handicapped by the fact that there is no true basis for comparison. Costs of operating the standardized abstracts system developed at Western Reserve have been carefully scrutinized, and an accounting is presented herewith. To our knowledge, however, no rigorous cost analysis has been performed on any other information retrieval system. Therefore, in a sense, the costs presented here are unique. They are not amenable to comparison with costs of other systems, since these have not been established. However, in qualitative terms, the comparative costs of the input unit operations are equal, or nearly so, with the exception of terminology control. This difference is made up for during the mass production of search results during output, and in the reduction of cost to the user of the service, as well as in the amount of time saved. Reference to Table 5.1 is a reminder that certain costs are equal for every system. It should be emphasized, then, that the dollars-and-cents cost of an operational system is difficult to estimate exactly, and that any attempt to do so will be meaningless until the scope of the operation is clearly projected in every detail.

The following Tables (6.1, 6.2, 6.3) have been prepared to show the proportion of every dollar spent on input into the system which goes to each of the several necessary operations. The first of these can be represented graphically as follows (Table 6.1):

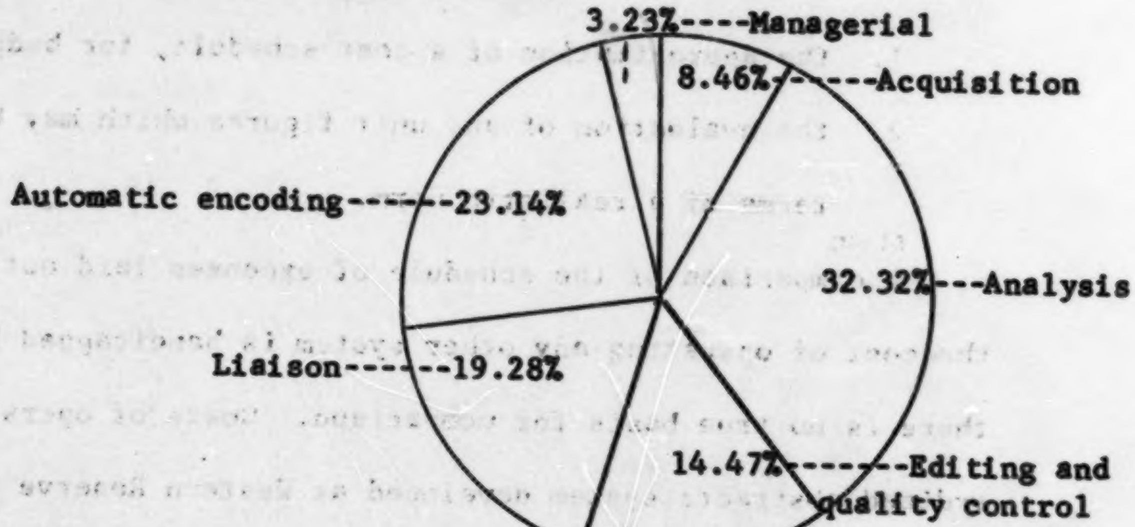

Table 6.1. Input Costs: by Operation

Table 6.2

Summary of Input Costs

Breakdown by Operations

	Per Cent of Total Cost
A. ACQUISITIONS	
1. Personnel	
a. Senior professional to determine acquisition policy for books, journals, etc.	
b. Acquisition clerk to check in documents and maintain records	
c. Junior professional to evaluate individual accessions, select articles for abstracting, etc.	
2. Equipment	
3. Subscriptions	
4. Supplies	
5. Fringe benefits	
6. Overhead	
Total acquisitions	8.46
B. ANALYSIS (Abstracting)	
1. Personnel	
2. Equipment	
3. Supplies	
4. Fringe benefits	
5. Overhead	
Total analysis	32.32
C. EDITING AND QUALITY CONTROL	
1. Personnel - junior professional	
2. Equipment	
3. Supplies	
4. Fringe benefits	
5. Overhead	
Total editing and quality control	14.57
D. LIAISON	
1. Personnel	
a. Typing	
b. Other clerical	
c. Supervising and expediting	

Table 6.2 (Con't)

2. Equipment
3. Supplies; stocking copies from Xerox 914
4. Fringe benefits
5. Overhead

Total liaison 18.28

E. AUTOMATIC ENCODING

1. Personnel

    a. Keypunching and verifying
    b. Other machine operations - sorting, collating, reproducing
    c. Card-to-tape conversion
    d. Supervising

2. Equipment--keypunches, verifiers, sorters, collators, reproducer, and file and storage cabinets
3. Supplies--IBM cards, tabe paper, magnetic tapes
4. Card-to-tape conversion--reading cards into GE 225 computer, $40/hr. charge includes personnel, equipment, supplies, fringe benefits, overhead
5. Fringe benefits
6. Overhead (except computer)

Total automatic encoding 23.14

F. GENERAL MANAGERIAL AND SUPERVISORY

1. Personnel
2. Equipment
3. Supplies
4. Fringe benefits
5. Overhead

Total managerial and supervisory 3.23

Total, all input operations 100.00%

Table 6.3

Summary of Input Costs

Breakdown by Type of Costs

	Per Cent of Total Cost
1. Personnel	58.05
2. Equipment -- computer	8.73
3. Supplies and subscriptions	14.30
4. Fringe benefits	2.93
5. Overhead	15.99
Total all input costs	100.00%

Before proceeding with a similar breakdown for the costs of question analysis, search, and output, it is necessary to interpose a list of variables which must be considered on making any such tabulation.

These variables include:

1. The maintenance of a staff that is adequate both in size and in capabilities. This stipulation may appear to be a rather surprising one in this context. In practice, however, it directly influences the cost of the output operations. Adequacy of size of staff is especially important in peak-load periods--and, of course, difficult to maintain in periods when the scheduled output is low.
2. The amount of specialization by the various personnel. Ideally, in a small and growing operation, there is more versatility and

therefore more flexibility available. Personnel can be deployed to the area where the current need exists.

3. The degree of complexity of the question, which has a direct effect on the time and cost of analyzing and structuring, and on the number of questions entered simultaneously in the computer for searching.
4. The degree of urgency to meet a delivery date, the time periods covered, and the scheduling, all of which affect the extent of efficient utilization of the computer.
5. The number of answers or the output of the computer, a variable which can only roughly be predicted. The greater the punchout, the slower the computer searches. The greater the number of answers, the slower the routines of review and processing before transmission to the subscriber.
6. The number of times that the same question is asked, reducing proportionately the number of times that the question need be programmed and the file searched.

With these variables in mind, the following table (Table 6.4) can be interpreted to show the output costs: question analysis, search, and transmission of answers to the questioner. The percentages are based on the analysis, structuring, automatic encoding (of the search structure), searching, review, and preparation of copies for mailing. The review operation assumes a fairly large proportion of the total costs, especially in the second (retrospective) schedule, where 2,000 cards, each representing a document, are examined, photocopies pulled, and evaluations made. This area is the target of the sharpening and refining procedures, outlined

Table 6.4

Summary of Output Costs

	Current Awareness Search* (1,500 documents; 20 simultaneous questions; 600-card output or 30 answers per question)		Retrospective Search* (85,000 documents, 5 simultaneous questions; 2,000-card output or 400 answers per question)	
1. Analyzing	9.87		2.42	
2. Structuring	70.92	81.58	17.42	20.03
3. Automatic encoding	.79		.19	
4. Searching				
a. Computer	3.15		29.95	
b. Other machine operations	.39		1.30	
c. Expediting and recordkeeping	.39		1.29	
5. Review				
a. 1st review	4.73	18.42	15.49	79.97
b. 2nd review**	2.66		8.71	
6. Transmitting answers				
a. Photocopies	4.26		13.94	
b. Assembling and mailing	2.84		9.29	
Total	100%	100%	100%	100%

*Sample searches over large and small files.

**Based on a rather high rejection, during the first review, of 25% of the computer output.

in Chapter 4 , instituted to make the structuring of the question--and the character of the resultant output--more exactly fit the questioner's request. Such procedures will cut down on and finally eliminate the need for review.

B. Sample Extrapolations

Certain estimates may be made of the operative costs for an information system. These estimates are, however, subject to all of the variables cited above. They are especially vulnerable in the area of policy-making, since the operational schedule upon which these figures and percentages are based is one that has had the benefit of several years' "shakedown," and managerial functions are proportionately reduced.

Table 6.5

Estimated Costs of Input

To Hypothesized Systems of Various Sizes

Input	@ Unit Cost	Input Cost
5,000	$7.50	$ 37,500.00
10,000	7.25	72,500.00
15,000	7.00	105,000.00
20,000	6.50	130,000.00

Notes: 1. Unit cost (per document) decreases as volume of input rises. 2. Unit cost includes all personnel, equipment, etc, shown in Tables 6.1 - 6.3, with the exception of the systems manager.

Table 6.6

Estimated Costs of Output

To Hypothesized Systems of Various Sizes

	Analysis Structuring Evaluating	Computer search Other machine work Expediting, etc. Providing photocopy Assemble and mail
Question Load	Personnel/year	Costs/year
5/week = 250/year	1 = $ 6,500	$ 3,562.50
10/week = 500/year	2 = 13,000	7,125.00
25/week = 1250/year	4 = 26,000	14,250.00
50/week = 2500/year	6 = 39,000	35,625.00
100/week = 5000/year	10 = 65,000	71,250.00

Notes: 1. Personnel figures shown do not include normal charges of 20% overhead and 5% fringe benefits. 2. Costs in column 3 are figures at a unit rate of $14.25/question. This assumes an average of 10 simultaneous searches of one tape, a 1,000-card output, and a rejection, on review, of 25% of this. 750 photocopies are thus assembled and mailed.

To the above charges will be added the costs of providing a System Manager. This (at Federal Grade 13) would be $9,890.00.

In summary, the determination of costs for the establishment and operation of an information center may be made on the basis of the following schedule, each heading of which deserves separate consideration:

I. Cost of pilot operation
II. Cost of operational service
  A. Capital costs
    1. For creating a searchable file
      a. Acquisition of materials
      b. Analysis of records
        (1) Reading and understanding record
        (2) Recording "clues"
          (a) Human
          (b) Machine
          (c) Language/code
    2. For purchase of a searching mechanism
  B. Operational costs
    1. Analysis of questions
    2. Operation of searching mechanism
    3. Providing results of searches
  C. Costs of not providing service

One or two other considerations should be added to the variables listed above. One is that the input cost is a direct function of the techniques employed in processing the literature. The better the techniques, obviously, the lower the costs.

The second is perhaps not so apparent. This is the relationship between the training level of the analysts and the cost of input. As the skill of the analyst increases, so does the cost of analysis. As in other areas of the operational system, decisions--often arbitrary ones--must be made with regard to optimum allocation of funds among the various unit operations. On the other hand, since limitations on the cost of input can lead to greater costs in use of the system, an arbitrary limitition on the cost of the system as a whole will generally increase the cost of input.

The third is that the cost of any part of the system, or of any whole system, can be evaluated only in terms of the criteria used to evaluate that part or that whole system.

CHAPTER SEVEN

GENERAL DISCUSSION OF PILOT PROJECT

A. Tentative Conclusions

At this point, it is well to consider how far the Pilot Project for an information service of educational research materials has gone, in the year since its inception. The philosophy and techniques of the Pilot Project have been detailed in Chapter 4. Also included in Chapter 4 are the results of that Project. In this chapter, we may summarize the work in a more general way, and point the way to future research.

1. Scope

Basic to the structure of the information system as it has developed is the definition of educational research--not as a lexicographical exercise, but as a necessary attempt to delimit the field, to recognize the salient features within such delimitations, and, finally, to establish a foundation broad enough for the structure which it must eventually support. Implicit here is the acknowledgment of the interdisciplinary multidimensional nature of the educational experience.

The present definition of educational research is a "working" one--even though it has been derived through a series of informed discussions, much research, many consultations with staff members of the Office of Education, and continued reappraisals up to and beyond the moment that it was finally and arbitrarily set. And just as the nature of what educational research "is," is independent of the arbitrary decision made to establish the present core, so the scope of the Educational Research Information Center--though nearly approximated by the present test--remains to be set. The scope is seen now only, as it were, through a glass darkly. Its final form will appear with the establishment of an operational service, informed not only by the experimental experience of the pilot project but also by the urgent nature of questions submitted by workers in the field and by the dynamic "feedback" from such questioners in response to the answers they receive.

2. Development and Flexibility

Thus the key word of the system is flexibility. This must continue to be the case, now and in the future. Any information retrieval system represents an ongoing development program. Some portions of the system, at any point of time, are operational. Other portions will always require development. This situation will exist as long as the fields of human knowledge continue to grow. As they expand, so must the perimeters of every system which hopes to contain them. If such a system is well designed, it will immediately reflect a change of emphasis. Its built-in flexibility will be ready to change as the interests of research workers change, forecasting new developments in the field. Yesterday's magic lantern is today's ETV. An information system must be flexible enough to remember the past, provide for the present, and prepare for the future.

The system under development for this project has provided flexibility in

a. **Acquisitions**: by a philosophy of establishing an arbitrary core but with the provision for extending the scope in any direction.

b. **Analysis**: by providing a framework within which any number of reference points can be provided for access in a search.

c. **Terminology control**: by providing control of an interdisciplinary conceptual type which will permit the inclusion of new terminology as it occurs.

d. **Searching mechanism**: by providing manipulative possibilities for exploiting the flexibility of analysis and terminology control.

e. **Delivery of search results**: by providing for either bibliographies, abstracts, or full documents.

B. Need for Future Research

> In educational research we are conducting investigations of the most difficult type. Experience and training and a constant evaluation of methods are imperative. All types of research are important from the most controlled experiment to the simplest demonstration. We should, however, endeavor to use an experimental design to solve important problems, rather than just to get an answer. Likewise, statistics should be used as the tools they are rather than to obscure important results.
>
> -- (Loran C. Twyford, "New Title VII Reports, With Proposals for Better Research," AV Communication Review, 10:1, Jan. -Feb., 1962, p. A-72.)

The above quotation from a review by Dr. Twyford, an engineer, psychologist and educator who is consultant on Educational Communications in the New York State Educational Department, serves to remind us at this point that experiment in educational research is not well-designed if it is done only for the sake of experiment. As we survey the past year and the experience it has provided in the establishment and operation of a

Pilot Program in the analysis, storage, and retrieval of the literature of education research, we are tempted to do many things at once. There is a tendency now to go back, retrace our steps, try to improve our methods, revise techniques, improvise and in general repeat our experience, so as to approach by successive approximations the excellence which is our goal.

But at the same time there is the need to quantify the data already gathered, to move from a brisk review towards a generalization of our experience, in order to form a basis for predicting, as exactly as may be, the parameters of the practical and practicable Educational Research Information Center. This latter need takes precedence. Immediate plans for research must have immediate relevancy to the task at hand.

Primary areas for investigation include:

1. Comparative evaluation of search strategies. Several of the searches made in the past year have utilized alternate strategies, run either simultaneously or consecutively with the original structure. A large proportion of the questions received lend themselves to alternate approaches from various points of view. Further experimentation should be made to determine the factors which influence the relevancy ratings of the output. The development of search strategy would therefore be related to basic unit operations and studied in terms of relevancy deriving from decisions made either during analysis (abstracting) or during evaluation of output. The relationship between these considerations and the cost of operational service has already been mentioned (Chapter 6).

2. Continuing appraisal of the semantic code. The corpus of semantic codes for education has been generated with the purpose of maintaining as nearly as possible a multifaceted point of view in order to reconcile the vocabularies of the several separate subdisciplines which are the province of education. The goal has been to create a code which will reflect the "meaning" of a word as it appears in *Psychological Monographs*, in *Modern Language Journal*, and in the *Harvard Educational Review*. This generalizing tendency has to be balanced, however, by an awareness of the code's unique function of concept identification. A review of the present code dictionary is in order, to guarantee the thesaural aspects of the code display as it now exists, in the light of a year's experience with its use.

There is a further possibility for terminological control which might be mentioned here, although it is perhaps more properly a subject for the review of comparative systems study (in 4, below). This is the controlled interpolation, into the philosophical (and practical) framework of the Telegraphic Abstract, of the insight gained from the study of comparative systems, specifically from subject-heading analysis. The opportunity here is to exploit that experience in order to achieve a better control of terminology. As stated early in this report, the expression of subject matter--as differentiated from that of the "hard" sciences--has presented a continuing problem. It may be that reference to an "intermediate" subject-authority list might aid analysts in the construction of the telegraphic abstract, especially where there seemed to be inconsistency in the usage of the original document. Such caution, reenforced by the safeguards of the Semantic Code, might be well worth while, and its application should be investigated further.

3. Evaluation of abstracting procedures begins with:
   a. A qualitative and quantitative study of the abstracting personnel, with the aim of tabulating those characteristics which best qualify the applicant for the job. Experience at the Documentation Center has been matched time and again with experience in other generally related establishments, such as *Chemical Abstracts*, always reaching the conclusion that much remains to be learned about the intellectual and psychological qualities, the education and training, and the other variables which provide the background for success in abstracting. The design of a test for such qualities is another challenge.
   b. Still another is the formulation of an economical and efficient method of teaching the techniques of telegraphic and conventional abstracting. Selection and training of abstracters at the Documentation Center has been accomplished largely on the empirical basis of a rather extensive experience over a period of seven years in various fields. Statistical and other fundamental evaluation of this experience remains to be done.
4. Comparative systems study. A cardinal obligation of the researcher in a field as new and ever-changing as documentation is the continual reappraisal of his system. Examination of the work of

others is useful not only per se, as a standard by which performance can be measured, but also as a source of ways to refine and improve existing methods. Although many of the tasks which carry out the unit operations of the present system are performed by machines, they are not automatic tasks. The computer's work must be planned and its raw materials prepared. In the case of literature searching, the planning of machine routines is rigorous and complicated. Once established, of course, the routines are set and the human work is largely done. The preparation of materials, on the other hand, is a constant and endless process. Routines can be established, but their application--the task of analysis--is done by human beings and its performance must be both encouraged and controlled. The development of a dependable automatic abstracting process that can be put to work on a variety of material may some day do away with the unit operation described as analysis. Until that day, the Center for Documentation and Communication Research will continue to devote its energy and attention to abstracting and indexing techniques, and to their editorial control.

The period preceding the inauguration of an operational system is critical in many ways, not the least of which is the necessity to spot any danger signals and to make necessary alterations in the system to correct whatever may be wrong. A pilot project in a new field presents its own idiosyncratic challenges. The duty of the designer of such a system is to meet each such challenge with a response individually tailored to the need.

The study of classification procedures has been carried out partly on the basis of the experiments discussed in Chapter 5, and partly by observation of the experience of others, as the computer-based bibliographic efforts of the National Library of Medicine. Various other system approaches (e.g., descriptor, uniterm, etc.*) can be demonstrated either through ancillary files or by simulation. As an example, the uniterm approach consists of the selection, from a document, of significant terms. These are recorded, ordinarily, in an aspect file and made available for retrieval, either manually or by computer, individually or in coordination. A uniterm search can be approximated, in the present system, by specifying, in the search structure, only terms without role indicators. As another example, the title "key word" index built into the telegraphic abstract can simulate KWIC* and other similar displays, permuted or otherwise, designed for retrieval purposes. Both such simulations retain the advantage of thesaural references built into the file by the use of the Semantic Code. These and other studies need to be pursued to the point that the pilot system will be ready for a sound and effective transition to operational status.

5. Study of users and their needs.
   a. The first area for analysis is the roster of individuals who have used the services of the pilot service, in order to determine:
      (1) their individual characteristics, in order to group these, as indicated, and to extrapolate the findings to form

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* See Glossary, Appendix F.

a picture of the whole body of potential questioners. To what extent, for example, does the field divide as expected among educational practitioners, researchers, and "laymen," i.e., those outside the field of education who are interested in this literature in relation to other disciplines? Another characteristic is the motivation of the questioner. To what extent does the field divide as expected among those who require background literature relevant to a research study, those who want an answer to a specific research problem, and those who want information for practical application? Information gathered here leads to the next consideration,

(2) their individual questions, in order then to group these, as indicated, and to correlate such groups by question-type with the several groups identified in (1) above.

Careful consideration must be given, in such a study, to the question of whether or to what extent these are "typical" questioners, and this consideration must affect the validity of the conclusions.

At this point a tentative generalization may be risked. It would seem that those engaged primarily in research are the most independent of the potential clients of an operational service. Highly sophisticated in their own specialized area of study and relatively sophisticated in related areas, they have well-developed opinions about the professional journals and other sources of literature, and seem to prefer close control over their own bibliographic activities. However, these are the very people whose questions most often require detailed analysis of the literature, and it is the deepest analysis which is most dependent on mechanized processing. Further, it is these users whose needs range most widely outside of the literature served by the traditional bibliographic tools of education. Thus, insight into the needs of researchers will enable the system to improve services in the two unit operations of acquisition of material and analysis of information content.

b. The second area for analysis is the way in which information may best be disseminated through an Educational Research Information Service. Several methods of dissemination are suggested:

   (1) the specific reply to a specific question, either by
      (a) bibliographic reference,
      (b) mechanically reproduced conventional abstract, or
      (c) mechanically reproduced copy of the original document.

   (2) a general reply to a general (or specific) question, by any of the means listed under (1). In this case, however, "packaged" bibliographies could be prepared and made available on request. Such bibliographies on topics of general interest such as "teaching machines" or "teaching of gifted students" could be generated in the regular searching routines or could be specially prepared by the staff. In either case, a list of available topics could be publicized in appropriate media throughout the field.

(3) the regular publication of a "current-awareness" bulletin containing copies of the conventional abstracts newly added to the system, or bibliographic reference to the documents processed. Arrangement in such a bulletin might be made on the basis of the faceted subject-heading classification developed for this project and described in Chapter 5.

c. A further area for exploration is the way in which the private files of the individual or organization may be coordinated with the services of the information center.

d. A final area in the consideration of user needs is the question of centralization vs. decentralization of the Educational Research Information Center. This leads to such opportunities as the duplication of files generated at the Center, for more convenient access at a number of regional locations.

These possibilities are explored in more detail in the discussion, in the following chapter, of ERIC, the Educational Research Information Center, and its ongoing literature surveillance and abstracting program.

CHAPTER EIGHT

EDUCATIONAL RESEARCH INFORMATION CENTER (ERIC)

A. Entire System

An operational information service developing out of this project would permit the U. S. Office of Education to serve educators and others having need of the results of educational research. ERIC could function both as a primary information agency to serve individuals directly, and as a central acquisitions and processing agency to supply other agencies or institutions with processed files for local exploitation.

A schematized function of this dual role is given below in Figure 8.1.

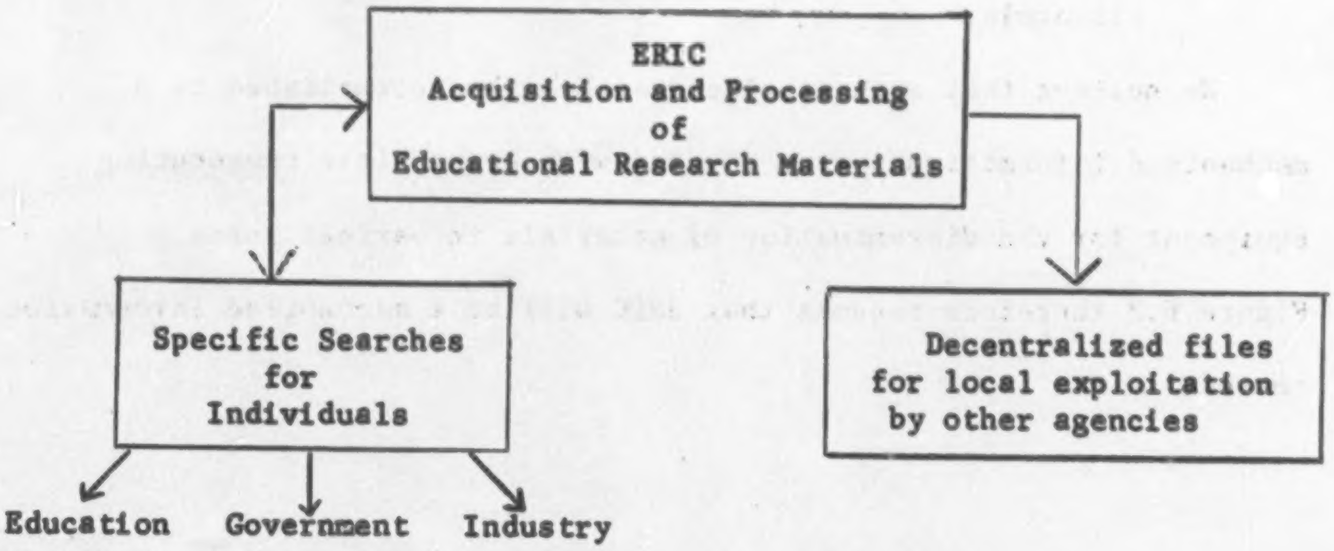

ERIC
Acquisition and Processing
of
Educational Research Materials
Specific Searches
for
Individuals
Decentralized files
for local exploitation
by other agencies
Education
Government
Industry

Figure 8.1

ERIC

In either role ERIC should be able to provide educational research materials in any form. Some of the major services which ERIC could provide are charted in Figure 8.2, page 115.

1. Searching the accumulating record of educational research production to provide at regular intervals current information on specific questions that are of continuing interest to individual users.
2. Searching the store of records retrospectively to provide information on a specific problem or make available the raw material for a review of the literature or other compendia.
3. Copying of the records and transmittal to a local installation for search and other exploitation.
4. Providing copies of abstracts and source documents for special subject fields in order to "stock" special libraries with the materials required to serve their clientele.

We believe that such services can best be accomplished by a mechanized information system coupled with appropriate reproducing equipment for the dissemination of materials in various forms. Figure 6.2 therefore assumes that ERIC will be a mechanized information center.

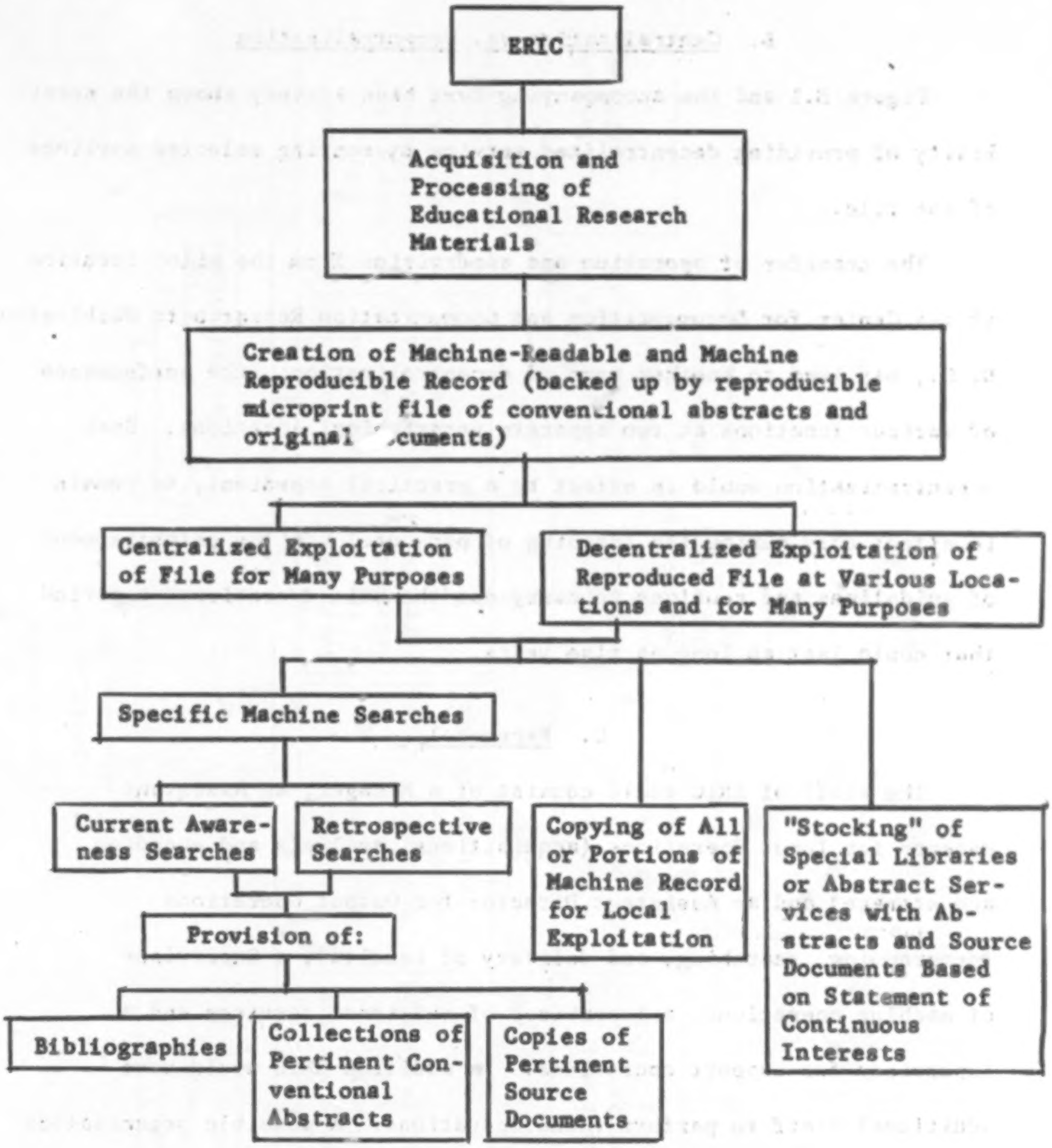

ERIC
Acquisition and Processing of Educational Research Materials
Creation of Machine-Readable and Machine Reproducible Record (backed up by reproducible microprint file of conventional abstracts and original documents)
Centralized Exploitation of File for Many Purposes
Decentralized Exploitation of Reproduced File at Various Locations and for Many Purposes
Specific Machine Searches
Current Awareness Searches
Retrospective Searches
Provision of:
Bibliographies
Collections of Pertinent Conventional Abstracts
Copies of Pertinent Source Documents
Copying of All or Portions of Machine Record for Local Exploitation
"Stocking" of Special Libraries or Abstract Services with Abstracts and Source Documents Based on Statement of Continuous Interests

Figure 8.2

SPECIFIC SERVICES OFFERED BY

EDUCATIONAL RESEARCH INFORMATION CENTER

(ERIC)

B. Centralization vs. Decentralization

Figure 8.1 and the accompanying text have already shown the possibility of providing decentralized service by copying selected portions of the file.

The transfer of operation and supervision from the pilot location at the Center for Documentation and Communication Research to Washington, D. C., may lead to another type of decentralization: the performance of various functions at two separate geographical locations. Such decentralization would in effect be a practical expedient, to remain in effect only during the training of personnel and the establishment of guidelines and routines to carry out the unit operations--a period that could last as long as five years.

C. Personnel

The staff of ERIC could consist of a Manager, an Assistant Manager for Input Operations (acquisitions, analysis and encoding, and storage) and an Assistant Director for Output Operations (programming, searching, and delivery of results), a Supervisor of machine operations, a Supervisor of reference services and a Supervisor for support operations. In addition ERIC would have additional staff to perform these operations. A possible organization of ERIC is shown in Figure 8.3, page 117. The functions of such a staff are described in some detail under Operations on Page 120.

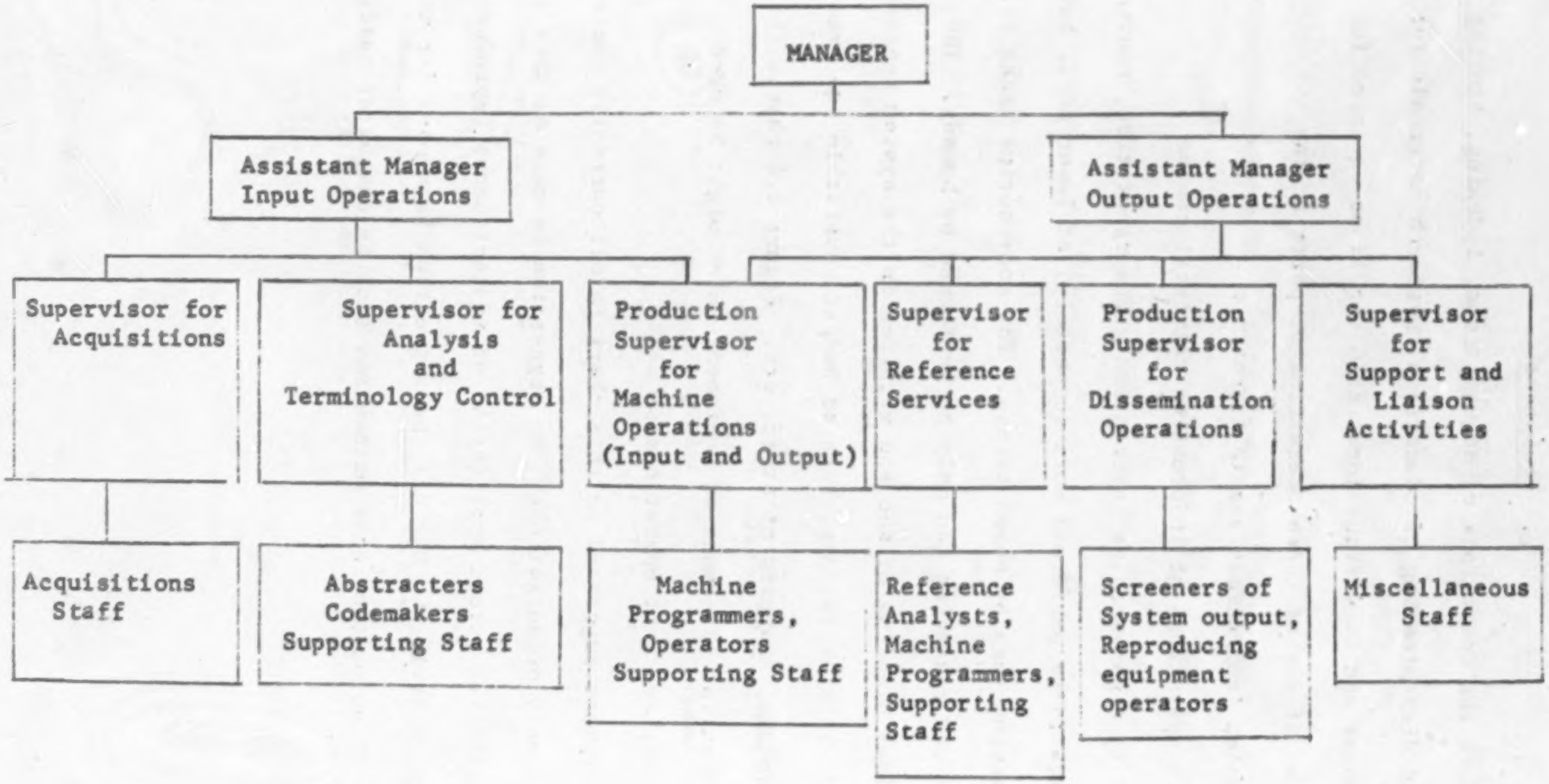

MANAGER
Assistant Manager Input Operations
Assistant Manager Output Operations
Supervisor for Acquisitions
Supervisor for Analysis and Terminology Control
Production Supervisor for Machine Operations (Input and Output)
Supervisor for Reference Services
Production Supervisor for Dissemination Operations
Supervisor for Support and Liaison Activities
Acquisitions Staff
Abstracters Codemakers Supporting Staff
Machine Programmers, Operators Supporting Staff
Reference Analysts, Machine Programmers, Supporting Staff
Screeners of System output, Reproducing equipment operators
Miscellaneous Staff

FIGURE 8.3

ORGANIZATION OF ERIC

D. Equipment

To perform the operations of acquisitions, indexing, storing, searching and disseminating of educational research materials for various purposes and in various forms ERIC should be equipped for the automation of any of these operations or parts of the operations which lend themselves to automation.

The unit operations of information retrieval can be accomplished by a man-machine interaction. The repetitive, routine tasks can usually be performed more accurately, at lower cost, and faster by machine than by human beings. The non-routine tasks calling for judgment and reasoning can only be performed by humans. The precise optimal blending of men and machines in the system depends on a variety of variable factors, such as budget, available equipment, production volume, training of staff, etc. Figure 8.4 charts the type and sequential placement of equipment which might be used to perform the various unit operations of ERIC.

The equipment suggested in this chart is all currently operational equipment in many organizations. No suggestion is made at this time as to the potential output application of instantaneous reproducing or transmission devices. Nor has the suggestion been made for the application of automatic input mechanisms such as character reading devices.

3

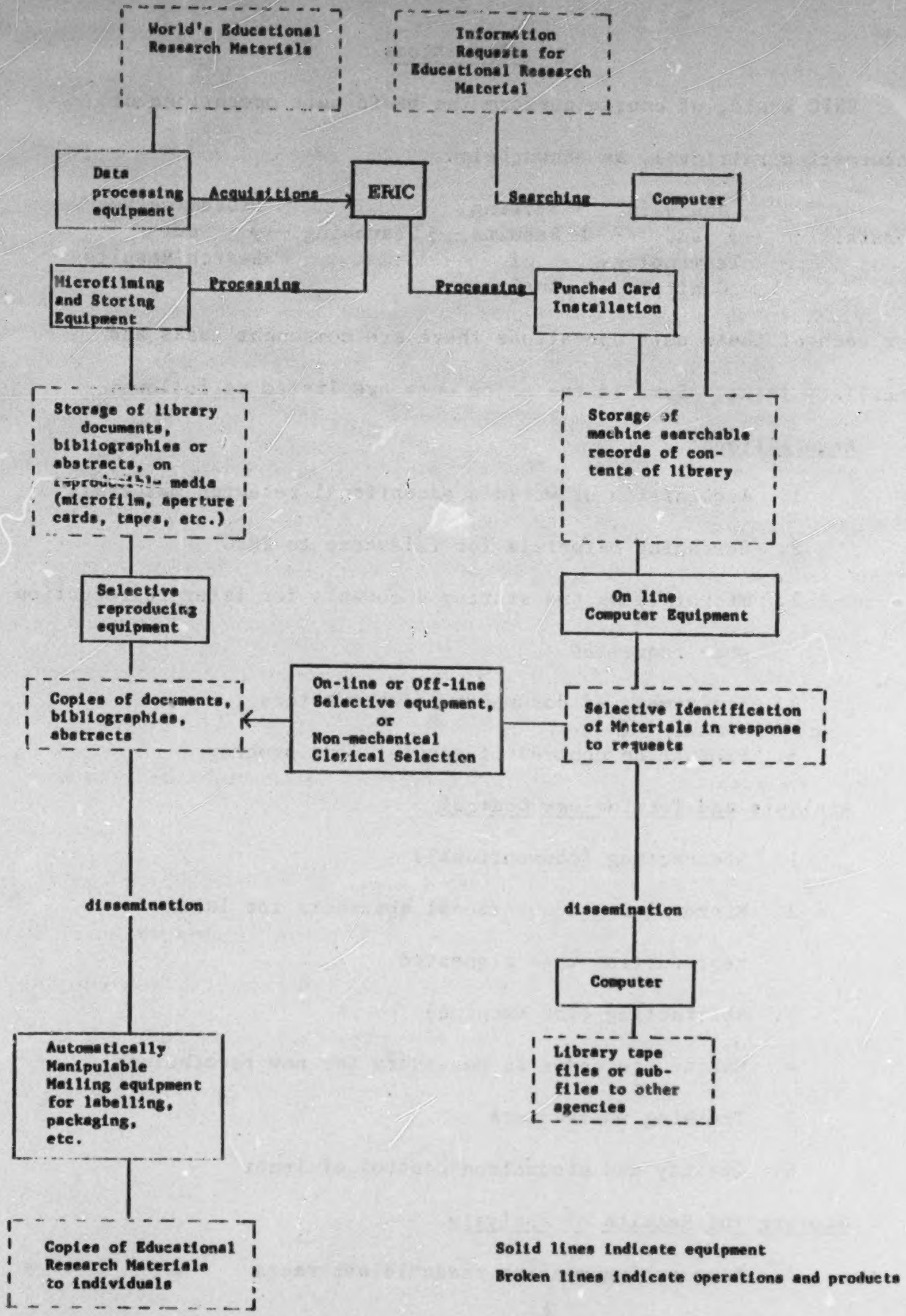

World's Educational Research Materials
Information Requests for Educational Research Material
Data processing equipment
Acquisitions
ERIC
Searching
Computer
Microfilming and Storing Equipment
Processing
Processing
Punched Card Installation
Storage of library documents, bibliographies or abstracts, on reproducible media (microfilm, aperture cards, tapes, etc.)
Storage of machine searchable records of contents of library
Selective reproducing equipment
On line Computer Equipment
Copies of documents, bibliographies, abstracts
On-line or Off-line Selective equipment, or Non-mechanical Clerical Selection
Selective Identification of Materials in response to requests
dissemination
dissemination
Computer
Library tape files or sub-files to other agencies
Automatically Manipulable Mailing equipment for labelling, packaging, etc.
Copies of Educational Research Materials to individuals
Solid lines indicate equipment
Broken lines indicate operations and products

FIGURE 8.4

CHART INDICATING TYPE AND PLACEMENT
OF EQUIPMENT WHICH MAY BE USED TO
PERFORM THE UNIT OPERATIONS OF ERIC

E. Operations

ERIC would, of course perform the basic unit operations of information retrieval, as shown below:

Acquisition ⟶ Analysis and Terminology Control ⟶ Storing Results of Analysis ⟶ Searching ⟶ Dissemination of Search Results

For each of these unit operations there are component tasks and ancillary tasks. Some of the major ones are listed as follows:

Acquisitions:

1. Acquisition of world's educational research materials
2. Screening materials for relevance to ERIC
3. Microfilming and storing documents for later reproduction when requested
4. Assignment of documents to abstractors
5. Production control of acquisitions program

Analysis and Terminology Control

1. Abstracting (conventional)
2. Microfilming conventional abstracts for later reproduction when requested
3. Abstracting (for machine)
4. Making new codes as necessary for new terminology
5. Training abstractors
6. Quality and production control of input

Storing the Results of Analysis

1. Keypunching machine readable abstracts
2. Automatic encoding
3. Transfer of records from card to tape

4. Quality and production control of machine input

Reference Services

1. Receipt of question
2. Analysis of question
3. Formulation of search strategies
4. Machine input and searching of question
5. Liaison with questioners
6. Screening of computer answers
7. Quality and production control of searches

Dissemination

1. Reproducing copies of requested materials in form requested:
    - a. full documents
    - b. abstracts
    - c. bibliographies of titles
    - d. magnetic tapes of machine readable abstracts.
2. Assembling and mailing materials to requestors:
    - a. On a regularly recurring basis for:
        - (1) current awareness service at regular intervals
        - (2) updating of files of tapes at regular intervals
        - (3) updating of packaged abstracts for libraries, special bulletins, etc. at regular intervals;
    - b. On an irregular basis for retrospective special searches on special topics.
3. Updating and culling mailing lists for announcements of special interest to various classes of users.

F. Capacity of ERIC

Since ERIC has been planned to take advantage of high speed mechanisms, its capacity will depend more on budgetary considerations than on any physical limit. Ideally ERIC should be able to provide access to the totality of relevant educational research -- past, present, and future. It should be able to satisfy any reasonably conceivable number of requests for information, for the more its services are used, the chesper the servicing of each individual request becomes.

A working hypothesis of the capacity of ERIC can be explained in terms of the unit operations as follows:

Input Operations:

Acquisitions and Processing: 10,000 documents per year to cover most important current production of educational research material.

Output Operations:

Servicing questions (Searching and Dissemination): 30 questions per week, to provide for the most urgent needs of educators in this country.

G. Cost of ERIC

It is impossible to predict eventual costs of operating ERIC, since the actual number of documents to be included is not yet known. Nor is there any firm estimate available with regard to number of questions that would be asked of the service.

However, it is reasonable to assume that the next stage of ERIC development can be handled adequately during the next 2 - 3 years, with a budget of $100,000 - $150,000/year. This figure to be allocated as follows:

75% (approx.) = input processing of 10,000 documents per year

25% (approx.) = servicing 30 questions per week.

H. Target Date for Operational Status

In predicting how soon ERIC can be fully operational, we must first define what is meant by "fully operational." Operational status can be discussed alternatively in terms of:

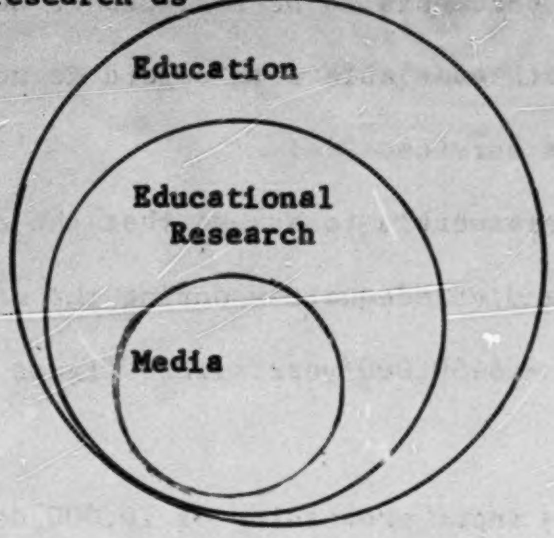
1. separate areas of subject matter becoming independently or gradually operational;
2. unit operations becoming independently operational.

As to the first alternative, for example, a probably feasible division of subject matter for the purposes of independent progress toward operational status would be:

1. media research;
2. educational research;
3. other literature of the field of education.

One and two can of course be undertaken concurrently.

With no attempt to compare the respective volumes of literature produced in each area, we may represent the three areas comprising the universe of educational research as



ERIC is aiming to provide service to the two smaller areas. Of these two areas, it is reasonable to expect that the smaller area, media research, could attain total coverage and processing of the literature and be ready for operation at an earlier date--perhaps by 1964.

The totality of educational research literature (exclusive of media research) requires a larger and more difficult program of acquisitions and analysis and would reasonably be slower in reaching operational status.

In the meantime while the Office of Education is taking over and operating the various areas comprising ERIC, research and development could be applied to the investigation of information retrieval systems for the remaining areas of education.

If the second approach to operational status is pursued by ERIC, then the various unit operations of the system must be examined in the light of the present and projected resources of the Office of Education. The Office of Education concurrently possesses such resources as:

1. trained subject specialists;

2. mechanisms for handling large volume mailing;
3. mechanisms for the receipt and handling of journal and reports and other literature.

These resources could enable them within one to two years to take over and operate the tasks involved in:

1. acquisition of materials;
2. screening the literature for documents relevant to ERIC;
3. writing of conventional abstracts;
4. receipt and analysis of questions;
5. screening of search results;
6. delivery of search results.

A second phase toward the ultimate total operation would be the training of analysts and editors for the processing of machine-readable indexes. From this trained group of specialists would be selected two or three who could then be trained to program questions and update the dictionary of encoded terminology as new terms are encountered. At this point ERIC should have access to a computer, for it would then become a completely self-contained operation offering all the services described in Figure 8.2, page 115 .

I. Services of ERIC

1. As an information processing agency, ERIC could provide files for local exploitation. These files could consist of any or all of the following:
   a. magnetic tapes for computer searching;
   b. copies of source documents;
   c. abstracts;

d. bibliographies;

e. dictionaries of encoded terminology.

2. As a primary information agency ERIC could provide information to individuals in the form of:

   a. source documents;

   b. abstracts;

   c. bibliographies.

3. ERIC will be geared to satisfy a full spectrum of information needs. It will be able to furnish information to individuals engaged in pure research. And it will also be able to furnish information to individuals who are charged with the task of establishing and presenting practical guidelines for application in teaching and administration.

ERIC's services would be available to individuals in government, academic institutions, educational agencies, and industry, wherever there is need for information from the vast and ever-growing literature of educational research.

APPENDIX A

PILOT LIBRARY

PART 1 · ACCESSIONS LIST
PART 2 - SOURCES OF UNPUBLISHED MATERIAL

APPENDIX A

PART 1

ACCESSIONS LIST

EXPLOITATION OF PERIODICAL LITERATURE

Source of Access	Abbreviation
Subscription*	subs
Scanned at nearby libraries	scan
Received from American Society for Metals	ASM
Table of Contents scanned in *Current Contents*	CC
Table of Contents scanned in *Content* (from Toronto Board of Education, Education Centre Library)	ECL
Deafness, Hearing and Speech Abstracts	DSH
Received from U.S. Office of Education	USOE
Evaluations:	
Wholly useful (every issue contains several useful articles)	WU
Occasionally useful (several useful articles during a year)	OU
Never useful (nothing of value that could not be found elsewhere in more useful form)	NU
No judgement	NJ
Evaluation by subject specialist	"1"
Tentative Evaluation by project staff	"x"

*Received from National Educational Association Through Plan 1

Present Access	Journal	WU	OU	NU	NJ	Proposed Access
subs	Administrators' Notebook	1x		1	11	subs
subs	Adult Education			x		drop
subs	AACTE Bulletin* (American Assn. of Colleges for Teacher Education)			x		drop
subs	AASA Research Bulletin* (American Assn. of School Administration)			x		drop
subs	AID - Autoinstructional Devices			x	1111	subs
ASM	American Journal of Physics		x		1111	ASM
CC	American Journal of Sociology		x1		111	CC
scan	American Psychologist		x1	1	11	scan
scan	American Journal of Psychology	11	x		11	scan
scan	Annual Review of Psychology	1x	1		1	subs
subs	Arithmetic Teacher*		x1	1	11	scan
subs	Art Education*			x		drop
subs	Audiovisual Communications Review	1x1			11	subs
subs	Audiovisual Instruction*			x		drop
CC	Australian Journal of Psychology		x	1	111	CC
subs	Automated Teaching Bulletin	11	x1		11	subs
scan	British Journal of Educational Psychology	1111x				subs
scan	British Journal of Psychology	11	x		11	scan
subs	Business Education Forum*			x		drop
subs	California Journal of Educational Research	1	x11		1	ECL
scan	Canadian Journal of Psychology		x		1111	scan

Present Access	Journal	WU	OU	NU	NJ	Proposed Access
subs	CTA Journal (California Teachers Assn.)			x		drop
subs	Catholic Educational Review		x11		11	scan
	Catholic Educational Research Monographs	1			111x	scan
scan	Child Development Abstracts	x111			1	subs
scan	Clearing House			x		drop
subs	College and University Bulletin*			x		drop
scan	College English			x		drop
CC	Contemporary Psychology	1	x	1	11	scan
subs	DHE Topics* (Department of Home Economics)			x		drop
subs	DSH Abstracts (Deafness, Hearing and Speech)	x1			111	subs
subs	Dissertation Abstracts	x111	1			subs
CC	Education	1	x1		11	CC
subs	Education Report		x			subs
subs	Educational and Psychological Measurement	1x111				subs
scan	Educational Forum			x		drop
subs	Educational Leadership*		x			scan
subs	Educational Record		x1	1	11	scan
scan	Educational Theater Journal		x		1111	scan
subs	Educational Research (London)	1x1			11	subs
subs	Educational Research Service Circular*	1	x	1	1	subs
subs	Elementary English		x1	1	11	scan
scan	Elementary School Journal		x			scan

Present Access	Journal	WU	OU	NU	NJ	Proposed Access
subs	Elementary School Science Bulletin*			x		drop
subs	English Journal		x	1	111	scan
subs	Exceptional Children*	1	x1	1	1	scan
scan	Film News			x		drop
scan	Fundamental and Adult Education (UNESCO)		x	1	111	scan
scan	German Quarterly		x			scan
subs	Harvard Educational Review		111x	11		scan
subs	High Points			x		drop
USOE	Higher Education		1x1	11		USOE
scan	Hispania			x		drop
scan	Human Relations		x		1111	CC
subs	Industrial Arts Teacher*			x		drop
scan	Journal of Abnormal and Social Psychology	111	x		11	subs
CC	Journal of American Society of Training Directors		x		1111	CC
scan	Journal of Applied Psychology	11	1x		1	subs
scan	Journal of Architectural Education			x	1111	drop
CC	Journal of Communication		x1		11	DSH
CC	Journal of Consulting Psychology		x			CC
CC	Journal of Counselling Psychology	1	x1		11	CC
scan	Journal of Education		1	1	11	NJ
subs	Journal of Educational Psychology	1111x				subs
subs	Journal of Educational Research		11x	1		subs
scan	Journal of Educational Sociology	11	x1		1	subs

Present Access	Journal	WU	OU	NU	NJ	Tentative Disposition
ASM	Journal of Engineering Education		x		1111	ASM
subs	Journal of Experimental Education	x111	1			subs
scan	Journal of Experimental Psychology	1111	x			subs
scan	Journal of General Education			x		drop
scan	Journal of General Psychology	1	1x		11	scan
CC	Journal of Genetic Psychology	11	x		11	CC
subs	Journal of Geography			x	1111	drop
subs	Journal of Health, Physical Education and Recreation*			x		drop
scan	Journal of Higher Education			x		drop
subs	Journal of Home Economics		x		1111	scan
scan	Journal of Medical Education		x		1111	scan
subs	Journal of Negro Education		1x		111	scan
scan	Journal of Personality		1x		111	scan
scan	Journal of Psychology	111	1x			subs
subs	Journal of Research in Music Education	x1			111	subs
subs	Journal of Secondary Education (California)		1x	1	11	scan
scan	Journal of Social Psychology	11	1x		1	scan
subs	Journal of Teacher Education*		x			subs
scan	Journalism Quarterly		1x		111	scan
subs	Kansas Studies in Education		1	x1	11	scan
USOE	Library Research in Progress	11	x		11	USOE
subs	Mathematics Teacher*		1x	1	11	scan

Present Access	Journal	WU	OU	NU	NJ	Tentative Disposition
scan	Modern Language Journal			x	1111	drop
CC	Monthly Labor Review		x		1111	CC
subs	Music Educators Journal*			x		drop
subs	NAEB Journal (National Assn. of Educational Broadcasters)		1x		111	subs
subs	NAJD Digest* (National Assn. of Journalism Directors of Secondary Schools)				x	drop
subs	NASSP Bulletin* (National Assn. of Secondary School Principals)	x	11		11	subs
scan	Nation's Schools			x		drop
subs	National Business Education Quarterly*		x			subs
subs	National Educational Secretary*			x		drop
subs	National Elementary Principal*			x		drop
subs	NAWDC Journal* (National Assn. of Women Deans and Counselors)		x		1111	scan
subs	NCAWE News* (National Council of Administrative Women in Education)			x		drop
subs	NCAWE Research Studies*				x	
subs	NEA Journal*			x		drop
subs	NEA Research Bulletin*	111	x	1		subs
subs	NEA Research Circular*	11	x	1	1	subs
subs	News Bulletin* (Department of Classroom Teachers)			x		drop
subs	News Exchange* (Assn. for Supervision and Curriculum Development)			x		drop
scan	North Central Assn. Quarterly		x1		111	scan

Present Access	Journal	WU	OU	NU	NJ	Tentative Disposition
subs	NRTA Journal* (National Retired Teachers Assn.)			x		drop
scan	Nursing Outlook		x			scan
scan	Nursing Research		x		1111	scan
subs	Ontario Journal of Educational Research	x1	1		11	subs
scan	Overview			x		drop
scan	Peabody Journal of Education		11x		11	scan
scan	Perceptual and Motor Skills	x	1		111	subs
subs	Personnel and Guidance Journal	1x	1		11	subs
subs	Phi Delta Kappan		11x	1	1	scan
scan	Psychological Bulletin	1111x				subs
scan	Psychological Monographs	1111	x			subs
scan	Psychological Reports	1	1x		11	scan
scan	Psychological Review	111x				subs
CC	Public Administration			x	1111	drop
scan	Public Opinion Quarterly	1	x		111	scan
subs	Pulse* (National Assn. of Public School Adult Educators)			x		drop
scan	Quarterly Journal of Experimental Psychology	11	x		11	scan
subs	Quarterly Journal of Speech*		x			DSH
subs	Reading Teacher		x			scan
subs	Research Quarterly* (American Assn. for Health, Physical Education and Recreation)	x11			11	subs
USOE	Research Relating to Children (United States Children's Bureau)	x111			1	USOE

Present Access	Journal	WU	OU	NU	NJ	Tentative Disposition
subs	Review of Educational Research*	x111				subs
subs	Rural Education Research Bulletin*				x	
subs	Rural Education News*			x		drop
scan	Scholastic Teacher			x		drop
scan	School and Society		x			scan
scan	School Board Journal			x		drop
USOE	School Life		x			USOE
scan	School Management			x		drop
subs	School Review		1x11	1		scan
scan	School Science and Mathematics		x1	1	11	scan
ASM	Science		x			ASM
subs	Science Education	1	1x	1	1	subs
subs	Science Education News (AAAS)				x	
subs	Science Teacher*			x		drop
subs	Social Education*		1x	1	11	scan
scan	Sociology and Social Research		x1		111	scan
scan	Speech Monographs		x			DSH
subs	Speech Teacher*		x			scan
subs	Spotlight* (National Assn. of Secondary School Principals)			x		drop
subs	Student Life* (National Assn. Secondary School Principals)			x		drop
subs	Studies in Art Education*	x			1111	subs
subs	Swap Shop* (National Assn. of Public School Adult Educators)			x		drop
subs	Teachers College Journal		x			scan
scan	Teachers College Record		11	x1	1	scan

Present Access	Journal	WU	OU	NU	NJ	Tentative Disposition
ASM	Technical Abstract Bulletin (Armed Services Technical Information Agency)		x			ASM
scan	Television Quarterly			x		drop
subs	Theory Into Practice (Formerly Educational Research Bulletin)	11	1x	1		gift
ASM	United States Government Research Reports	1	x		111	ASM
gift	Bulletin of Education (Kansas)		x			scan
subs	Vocational Guidance Quarterly		x			scan
scan	Volta Review		x			DSH

Periodicals Scheduled for Scanning

Administrative Science Quarterly

American Biology Teacher

American Business Education

Australian Journal of Education

Behavioral Science

Biological Abstracts

British Journal of Educational Studies

Bureau of Educational Research Monographs (Ohio State University)

Comparative Education Review

College English Association Critic

College Language Association Journal

College Composition and Communication

Educational Administration and Supervision

Educational Horizons

Educational Studies and Documents (UNESCO)

Florida Journal of Educational Research

Illinois Education

International Review of Education

Journal of Broadcasting

Journal of Chemical Education

Journal of Education in Librarianship

Journal of National Institute of Audiovisual Education

Journal of Verbal Learning and Verbal Behavior

Kentucky School Journal

La Education

Library Quarterly

Library Trends

Monographs for Education

NCME Yearbook

Occupation Abstracts

Psychometric Society Monographs

School Libraries

Superior Student

Technical Education Abstracts (Great Britain)

University Film Producers Association Journal

University of Kansas Bulletin of Education

Journal of Experimental Analysis of Behavior

APPENDIX A

PART 2

SOURCES OF UNPUBLISHED MATERIAL

I. Responses to the form letter were received from the following organizations selected from Section 1, "Education," of the Directory of University Bureaus and Institutes, Gale Research Co., Detroit, Michigan, 1960.

Arizona State University
  Bureau of Educational Research and Field Services

University of Buffalo
  Educational Research Center, Western New York School Study Council

Butler University
  Bureau of Research and Clinical Services

Central Michigan University
  Dept. of Special Studies

University of Chicago
  Comparative Education Center
  Midwest Administration Center

Columbia University
  Horace Mann-Lincoln Institute of School Experimentation

Cornell University
  Office of Field Services

De Pauw University
  Bureau of Testing and Research

Florida State University
  Educational Research and Testing

University of Georgia
  Bureau of Educational Studies and Field Services

University of Houston
  Bureau of Educational Research and Services

University of Illinois
  Bureau of Educational Research

State University of Iowa
  Bureau of Educational Research

Kansas State Teachers College
  Bureau of Educational Measurements

University of Kansas
  Bureau of Educational Research and Service

Kent State University
  Bureau of Educational Research and Service

Lehigh University
  Bureau of Educational Service

Michigan State University
  Bureau of Educational Research

University of Minnesota
  Bureau of Educational Research

Mississippi Southern College
  Reading Clinic

Ohio State University
  Bureau of Educational Research and Service

University of Oregon
  Bureau of Educational Research

Pennsylvania State University
  Office of Educational Research,
  Dept. of Educational Services

Prairie View A. and M. College of Texas
  Prairie View Research Committee

University of Puerto Rico
  Division of Educational Research

Purdue University
  Division of Educational Reference

University of South Carolina
  Bureau of Research

Southern Illinois University
  Educational Research Bureau

Stanford University
  School Planning Laboratory

University of Texas
  Bureau of Laboratory Schools

II. Responses to the form letter were received from the following organizations selected from Section 2, "Social Sciences," of the Directory of University Bureaus and Institutes.

Antioch College
  Engineering Psychology
  Research Project

University of Buffalo
  Creative Problem Solving Institute

Catholic University of America
  Bureau of Social Research

Columbia University
  Bureau of Applied Social Research

University of Illinois
  Institute of Communications Research
  Laboratory of Personality
  Assessment and Group Behavior

Michigan State University
  Communications Research Center

University of North Carolina
  Psychometric Laboratory

Stanford University
  Institute for Communication Research

Vassar College
  Mary Conover Mellon Foundation

Western Michigan University
  Center for Communication Research

III. Responses to form letter were received from the following organizations selected from Section 8, "University-Wide Programs," of the Directory of University Bureaus and Institutes.

University of Cincinnati
  Research Foundation

Drexel Institute of Technology
  Office of Research

Stephens College
  Research Service

Utica College of Syracuse University
  Research Center

IV. Responses to form letter were received from the following individuals selected from "Directory of Automated Teaching," Automated Teaching Bulletin, vol. 1, no. 4, Spring, 1961.

Miss Millicent Alter
New York University

Dr. Frank Banghart
Division of Educational Research University
of Virginia

Dr. Alexander Bassin
Kings County Court, Brooklyn, New York

Mr. Edmund C. Berkeley
Science Materials Center,
Newtonville, Mass.

Dr. Sidney L. Besvinick
University of Miami

Dr. Forbes Bottomly
School District 81, Spokane, Wash.

John C. Cook
North Carolina State College

Dr. John E. Coulson
Systems Development Corp.

Dr. Harry F. Silberman
Systems Development Corp.

Dr. Robert E. Silverman
New York University

V. Responses from the following were received in answer to requests for material noted in the bibliography of educational media received from the Division of Academic Research and Services, Pennsylvania State University, and in miscellaneous other sources.

University of Alabama

Alabama State Dept. of Education

American Institute for Research

American Medical Association

Association of American Medical Colleges

Bell Telephone Laboratories

British Information Services

British Broadcasting Corporation

University of Buffalo
   Western New York School
   Study Council

University of California
   Dept. of Engineering

Canadian Broadcasting Corp.

Center for Programmed Instruction

Clearing House of Ongoing Research

Cincinnati Public Schools

University of Colorado

Connecticut State Dept. of Education

Council on Medical Television

University of Detroit

Ford Foundation
   Office of Reports

George Washington University
   Human Resources Research Office

George Peabody College for Teachers
   Dept. of Education

IBM Corporation

Institute Pedagogique National

University of Michigan
   Research Center for Group Dynamics

Ministere de l'Education Nationale

National Academy of Sciences
   National Research Council

Michigan State University
   National Project in Agricultural
   Communications

National Association of Educational Broadcasters

National Educational TV and Radio Center

Ontario College of Education
   Dept. of Educational Research

Oregon State College

Pennsylvania State University
    Division of Academic Research and Services

University of Pennsylvania

Purdue University
    Audio-Visual Center
    Dept. of Modern Languages

Rensselaer Polytechnic Institute

San Diego State College

San Francisco State College

Southern Illinois University
    Morris Library

Systems Development Corporation

Television Information Office

University of Toronto
    University Press

Union College
    Laboratory of Psychology

U.S. Air Force
    Human Resources Research Laboratory
    Bolling AFB
    Tyndall AFB
    Wright-Patterson AFB
    Keesler AFB

U.S. Army
    Signal Corps Scholl
    Adjutant Generals Office
    Quartermaster Training
    Command

U.S. Dept. of Agriculture

U.S. Navy
    Office of Naval Research
    School of Aviation Medicine
    Training Devices Center

Utah State University

State College of Washington

Wayne State University
  Mass Communications Center

Western Illinois State College

University of Wisconsin
  Television Laboratory

VI. Responses to the form letter were received from the following organizations listed in Appendix I, Teaching by Television, Second Edition, the Ford Foundation, 1961.

University of Akron

Alabama In-School ETV Program

Alabama Public Schools

Chelsea Closed-Circuit TV Project
  (New York City)

Chicago City Junior College

Des Moines and Polk County Public Schools

Detroit Public Schools

Florida ETV Commission

University of Houston

University of Illinois

Kansas City Public Schools

Miami University, Oxford, Ohio

Michigan Department of Public Instutions

Midwest Program on Airborne Television
  Instruction

Milwaukee Public Schools

Nebraska State Department of Education

University of New Hampshire

Norfolk Public Schools

San Francisco State College

Southern Illinois University

Southwestern Indiana ETV Council

Twin City Area ETV Corporation

Wayne State University

Western Interstate Commission for Higher Education

APPENDIX B

ANALYSIS

PART 1 - PREPARATION OF CONVENTIONAL ABSTRACTS FOR LITERATURE IN EDUCATIONAL RESEARCH

PART 2 - PREPARATION OF TELEGRAPHIC ABSTRACTS FOR LITERATURE IN EDUCATIONAL RESEARCH

PART 3 - ORIGINAL DOCUMENT

APPENDIX B

PART 1

PREPARATION OF CONVENTIONAL ABSTRACTS FOR LITERATURE IN EDUCATIONAL RESEARCH

PREPARATION OF CONVENTIONAL ABSTRACTS FOR LITERATURE IN EDUCATIONAL RESEARCH

The Conventional abstract (CA) is like the Telegraphic Abstract in that it summarizes the information contained in the document. It includes all concepts which have significance to the researcher in education.* Very generally, it may be expected to include statements covering:

1. Purposes of study
2. Procedures
3. Findings

At this stage in the development of a pilot research project, the Conventional Abstract serves one chief purpose: it stands as proxy for the original document as the "product" of the search, and is for this reason vital in the literature searching service. A copy of the Conventional Abstract is sent to the questioner who must decide, solely upon the basis of the information which it contains, whether the article is in fact an answer to his request. He reads the Conventional Abstract in order to evaluate the topical emphasis and the research design of the study; if these satisfy his requirements, he will want to find a complete bibliographic reference to the original document, so that he can acquire and read it. The Conventional Abstract must meet all of these criteria, the implementation of which is described in the paragraphs which follow.

---

*Refer again to the discussion, in the manual for preparation of Telegraphic Abstracts, of significant words. Be sure that every person, process, device or attribute meeting these criteria, described in the text of the document, is adequately and clearly indicated in the Conventional Abstract.

A. BIBLIOGRAPHIC DATA

1. Choose the appropriate format for the abstract, according to the type of material:
    - a. Article or abstract in journal, or abstract from a regular compilation of abstracts, such as Dissertation Abstracts.
    - b. Book or monograph by a single author, including unpublished documents.
    - c. Separate chapter or abstract, by one of the various authors, in an edited or compiled book or monograph.
    - d. Monograph in series, including Cooperative Research and Title VII Reports.

    (Sample forms for a - d, above, are included at the end of this manual.)
2. Include the number of references in the original documents, at the end of the abstract.

B. PURPOSE OF STUDY*

The Conventional Abstract must include a statement of the purpose of the study.

C. DESCRIPTION OF PROCEDURES*

1. General methodology (survey, experiment, etc.).
2. a. Academic subject area. For several subjects in one area, a general term (e.g., "social studies") may be used.
   b. Teaching methods and devices, where significant as variables.
3. Characteristics of population:
   a. Size
   b. Location (school level, type and/or name, geographic place name)
   c. Grade level
   d. Age
   e. Other significant characteristics:
      1. Psychological
      2. Physical
      3. Demographic
4. Sampling procedures, such as matching of variables, etc.
5. Experimental treatments, manipulations, data collection. If only a few tests are used, designate these separately. If many are used, designate the general type (e.g., "personality and achievement tests").

---

*General Note. Any of these points should be omitted if it is clearly expressed in the title.

6. Methods of data analysis used. Be sure to include exact statistical method where given.

D. FINDINGS AND EFFECTS*

1. All findings relevant to major purposes or hypotheses.
2. Correlations obtained, with their levels of significance where given. Similar observations regarding any other statistic. (Include lack of correlation, as where a variable is tested for its effect and no significant effect is found.)
3. Ancillary or by-product findings where noted, i.e., important information which the study was not specifically designed to find.
4. Major conclusions: "the moral of the story"; interpretation of findings. While implications may appropriately be mentioned, recommendations should not be included.

E. STYLE

1. The shortness (50-100 words) of the Conventional Abstract requires a style that is concise, unambiguous, and smooth. While a verb may be omitted if it is clearly implied, sentences must convey a complete thought. The abstracter must avoid dangling particples, uncorrelated phrases, and ambiguous punctuation.

---

*See footnote on previous page.

2. Do not repeat information from the title.

3. Avoid tautology and cliché. Choose single words instead of phrases:

   by instead of by means of

   showing instead of it is shown that

   Avoid overworked or meaningless words and phrases such as:

   author states

   is discussed

   feature

   data are given for

   statistical analysis shows

   Be aware of your own habits, and guard against developing stylistic mannerisms which will not only make all your abstracts sound alike, but also mask the information content of the original documents.

4. Abbreviations

   a. In title or bibliographic data, use only those which appear in the original.

   b. Avoid all but widely-understood initials, such as FM, TV, IQ, UNESCO, and U.S. Use other initials common in the subject field, such as NEA, CCTV, ETV, and test initials, only after a previous full-name mention in the abstract.

   c. Regularize bibliographic abbreviations:

      vol.______ volume (in Arabic numerals)

      no. ______ number

      pp.__-__ page range

—pp. for a total number of pages

__ref. total number of references

5. Title VII and Cooperative Research Reports
    a. It will be assumed that any report on educational uses of audiovisual media supported by the U.S. Office of Education is supported under Title VII of the National Defense Education Act (NDEA), and that any report in other areas of education, supported by the U.S. Office of Education, was done under the Cooperative Research program. These authorities, even when not described as such in the document, will be presented as follows, in the space provided for "name of series:"

        NDEA Title VII Report, Project no.____
        (or NDEA Title VII Report, Grant no.____)

        Cooperative Research Report no.____

    b. Title III, VII, etc. of NDEA are the only exceptions to the rule that Arabic numerals will be used.
6. From time to time, "Abstract Notes" are issued for your guidance in specific points. File them with your copy of this manual.
7. You are responsible for the accuracy and clarity of your own work. Write or type carefully, distinguish capitals from small letters and read over your work before you hand it in. We cannot expect our typists to know the terminology of education and psychology well enough to supply words or connectives which you omit or express ambiguously.

Sample Forms
for
Conventional Abstracts

(Article or abstract in journal)

__________________. ______________________________.
Abstract no. Title of Article

____________________________. _______________________________.
Author (s) Journal Title

____________, _____, __________, ______________.
vol. no. Date Paging

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____ ________Refs.

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Abstracter

(Non-serial monograph or book)

(Abstract No.).......... (Author)..

(Book Title)________________________________, Chapter.........

(City).............................: (Publisher)....................

(Year).......... pp..................

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____ ________Refs.

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Abstracter

(Individual chapter in an edited book)

(Abstract No.).......... (Title) ....

Chapter.....in
(Author).............................. Abstract in (Book Title)

(editor)
________________________________, (compiler)...............

compiler.
......................., ed(s). (City).........................

(Publisher)..........................., (Year)........, pp...........

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____ ________Refs

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Abstracter

(Monograph in series)

Abstract No

Author(s), Editor(s) or Coordinator

Title of Book or Report

Series

Publisher

Publication Date

No. of pages pp.

Refs

Abstracter

SAMPLE CONVENTIONAL ABSTRACT

S-0128. Ronald J. McBeath. A Comparative Study on the Effectiveness of the Filmstrip, Sound Filmstrip, and Filmograph for Teaching Facts and Concepts. NDEA Title VII Report, Project no. 462, University of Southern California, 1961. 22 pp.

Experiment with 558 sixth grade pupils from Los Angeles County, grouped according to IQ, age, sex, and socio-economic status of father. Preparation of social studies lesson by means of silent captioned filmstrip, captioned filmstrip with recorded narration, sound filmstrip and 16 mm. sound filmograph. Administration of pre-test, post-test and retention test; analysis of results by variance and Tukey test. Effect of sex and IQ on achievement, and interaction between sex and presentation method.
56 refs.

(Note: Complete document follows manual for Telegraphic Abstracts)

APPENDIX B

PART 2

PREPARATION OF TELEGRAPHIC ABSTRACTS FOR LITERATURE IN EDUCATIONAL RESEARCH

PREPARATION OF
TELEGRAPHIC ABSTRACTS FOR LITERATURE
IN EDUCATION

Introduction to the Documentation Center

The Documentation Center at Western Reserve University conducts basic research in documentation, communication, and communications theory. Applied research is conducted in several fields, including metallurgy, medicine, engineering, law and education.

The general problem in documentation is to determine the best way to disseminate the information contained in current literature: that is, to make the published results of research available to workers in the field. Accordingly, the Center has developed a document-processing system, consisting of three main procedures:

a. Analysis, in order to determine the significant concepts which each document contains.

b. Storage, in order to preserve the results of analysis in an accessible file.

c. Retrieval, in order to get back, on demand, the information represented in the field.

The specific project for which this manual has been prepared is concerned with the documentation of education research literature, which is defined to include report and review literature dealing with empirical investigations of problems connected with the educative process. For this project we are acquiring material on organized education in all fields (academic, vocational, professional, corrective, etc.) at all levels, with a large proportion of studies on the use of the newer audiovisual media in education.

A. Analysis

A document may be analyzed in many different ways. The Table of Contents of a book is an analysis of the significant concepts which it contains. The Index of a book is another, more detailed analysis. Subject headings, in a library card catalog, represent the librarian's analysis of a document. A fourth form of analysis is a summary, or abstract, such as those which often accompany articles on technical subjects. Authors may be requested to boil down--analyze--their articles to make such a summary.

The telegraphic abstract, which is part of the WRU system of information retrieval, forms a fifth kind of analysis. Like an index, the telegraphic abstract (TA) lists important concepts contained in a document. Like an abstract, it shows how those concepts are related to each other in the text. Like the headings in a card catalog, it makes the document available to a reader who is interested in any of of several specific fields included in the range of educational interest.

B. Storage

After the process of analysis has been completed, the original document is stored by conventional library methods, either at the Center itself or in one of several associated collections. The telegraphic abstract must be stored in a more accessible form. The words which it contains now represent the only clues by which the original document can be traced. At present, magnetic tape is used to record the telegraphic abstract. Reels of magnetic tape, each representing several thousand abstracts, become, in effect, the library of the system.

C. Retrieval

When a question is addressed to the file, it puts into operation a series of human and machine functions which result in a program by means of which the files can be searched. The question is analyzed to yield a set of clues. The searching strategy consists in expressing these clues in such a way that they will match identical clues in any of the telegraphic abstracts recorded on tape. The physical search is made through the agency of a computer, the GE-225, which rapidly scans the reels of magnetic tape on which the telegraphic abstracts are recorded. The computer automatically checks each abstract for appropriate information, and prints out numbers which serve to identify documents which "answer the question," that is, provide relevant information.

This description of the machine procedure is intended to make clear the importance of the telegraphic abstract. The terms in the telegraphic abstract are, in effect, the key to the whole system, since it is only through them that the original document can be reached.

Definition and Purpose of the Telegraphic Abstract

A telegraphic abstract is a detailed index to a piece of literature. It is made up of (1) significant words selected from the title and text of a document; (2) symbols called role indicators which fit the selected words into context so as to express the type of relationship these words have to another; and (3) punctuation symbols which separate and group the words and role indicators into units which indicate the different degrees of relationship these words have to one another.

The words selected for the telegraphic abstract are transferred onto magnetic tape in a form of artificial language called semantic code. The codes are designed in such a way that words sharing in part or in whole the same concept will be related to each other. In effect, then, an encoded telegraphic abstract serves as its own thesaurus.

The telegraphic abstract, therefore, is a method for recording important characteristics of information contained in a document so that the information may be further processed for machine storage, where it will serve as an index, enabling the document to be retrieved at a later time by machine in answer to specific requests for information. The design of the telegraphic abstract is part of an overall logic which also dictates the design of the semantic code and of the strategy by which the information is searched. The telegraphic abstract, semantic code and search strategy together provide the key elements of a mechanized information retrieval system.

Role Indicators and Their Meanings

The role indicator is a device used in the telegraphic abstract to relate the items of information. It serves a two-sided purpose: to record each item in terms of its context in a document, and to avoid ascribing to an item a function which it does not serve. In presenting and explaining the role indicators, it will be helpful to place them in the basic categories of information found in most education research reports:

1. Population

KEJ: population or thing acted upon and/or studied. (examples -- student, parent, teacher, class; film, model, telecast, textbook)

KWV: attributes given for KEJ. (examples -- gifted, young, retarded, interested; large, component (by name), topic of film or book)

KIS: environmental or geographical location, by name or type. (examples -- classroom, elementary school, home; Western Reserve University, Cleveland, Ohio)

KEW: person interviewed or answering questionnaire. (examples -- principal, student, citizen)

2. Process

KAM: major process carried out on, by, or in relation to KEJ. (examples -- selecting, testing, team teaching, teacher training; discussion, reading, drilling; data analyses)

KAH: condition of process: including auxiliary process. (examples -- reinforcement, rapid, block time, ability grouping, branching)

KQJ: media or agent of process.
(examples -- TV, filmstrip, teaching machine;
teacher, specialist;
Stanford Binet test, chi square)

KWV: attributes given for KQJ.
(examples -- linear sequence, closed circuit, sound;
trained, part-time, female;
modified)

KEC: curriculum (material taught). (examples -- reading, music, geography, Spanish --only where the teaching of the subject is described)

3. Findings and Achievements

KUP: attribute or behavior found (or to be found). (examples -- ability, attitude, learning, motivation; cost, usage, validity)

KAP: attribute or behavior influenced -- examples above, KUP.

KWC: that toward which an attitude is noted. (examples -- job, teacher, peer, TV)

KAL: influencing factor, including inhibiting influence (positive or negative correlation).
(examples-- master teacher, parent, film; core curriculum, drilling, counselling; perception, IQ, sex, opinion; duration, cost, format, branching)
Almost anything may be identified as an influencing factor -- person, device, process, or attribute.

KXL: not an influencing factor (no correlation found).
(any variable, the effects of which a study attempts to find, which proves not to have the effects sought)

KWJ: product (device or material prepared)
(examples -- film, textbook, test, model)

KWV: attribute of product.
(examples -- see KWV above, those attributes denoting material or content characteristics)

4. Design and Conditions of Study

KAB: type of literature, design of study.
(Only the following classifications may be used -- research, survey, book review, bibliography, report, theory development, case study, historical analysis, dissertation).

a. When "dissertation" is used, one of the other KAB terms should be identified as well.
b. Types of research literature should be identified by the following terms -- research review, research proposal, research in progress; a report of a single completed study is identified by using "research" alone.
c. Modifiers, where appropriate, should appear on a separate line sharing the same role-indicator, e.g., critical bibliography, normative or longitudinal survey.

KIS: where research is done.
(examples -- New York U, US Naval TDC, Bell Telephone Lab)

KQJ: source of support, by name.
(examples -- Ford Foundation, NDEA Title 7, Cooperative Research)

KIT: year of original publication.

It is often desirable to combine role indicators in one space, in order to avoid repeating words which have more than one function. When role-indicators are combined, they must be clearly separated by a space.

Possible combinations include:

KEJ KEW: population being studied and interviewed.

KUP KAP: attribute found and influenced (very common; KAP rarely appears alone, although, of course, KUP may often be used alone).

KQJ KWJ: device or test for which development is described.

KAL KXL: sometimes an influencing factor, sometimes not.

KUP KAL: attribute found which proves to be an influencing factor.

KEJ KEC: a specific curriculum under study.

Punctuation

1. Comma (,) after role indicator(s) separates it (them) from the word or words.
2. Single dot (.) before role indicator separates role indicator-word combinations from each other.
3. Double dot (..) before role indicator separates one "phrase" of related words from the other phrases.
4. Box and three dots (□ ...) separate "sentences" from one another. "Sentences" are less closely related to one another than are phrases within a sentence.

A whole abstract may be thought of as a "paragraph." Most articles and other documents can be expressed in a telegraphic abstract by one "sentence," so that the □ ... punctuation will not be needed. A document dealing with two or more unrelated or only loosely related topics will require an abstract divided into sentences by the □ ... punctuation; an example might be a review of several loosely-related research studies.

Phrases

Certain role indicators may be thought of as basic to every abstract, each the nucleus of at least one phrase describing related factors. Such focal role indicators, required in every abstract, are KAB, KEJ, KAM and KUP.

The following groups of role indicators appear together commonly as phrases, set off from other combinations by double dots (..).

..KEJ, .KWV, .KIS,	subject of process (e.g. population taught or studied), its composition, attributes, and/or location
.KEC, .KAM, .KQJ, .KAH,	subject taught, means, conditions, and/or methods
..KWJ, .KWV	product developed, its composition and/or properties
..KAM, .KQJ, .KAH,	process, means or agent, and/or conditions
..KAB, .KQJ, .KIS, .KIT,	design, location and sponsor of study, and year of publication
..KUP KAP, .KAL,	attributes found and influenced, and factors influencing them.

Further Rules of Usage for Punctuation and Role Indicators

1. KAL or KXL may never be used unless there is a KAP in the same phrase, and vice versa.

2. Where KQJ or KAH is used for some but not all processes named, those processes not affected by the given agents or conditions must be put into a separate phrase by double dots (..).

3. To indicate that a KWV describes certain populations, material (s), device (s), or agent (s), but not others, the objects thus described are distinguished by separating them from the others with double dots.

4. KAM phrases describing research, testing and learning activities are set off from each other by double dots (..).

5. Where KEC is used, KAM is often superfluous. It is needed only where specific teaching or learning processes are noted, such as team teaching or memorizing.

It is often desirable to let several words on consecutive lines share a role indicator if they are all part of the same material or process. The result may read ambiguously, but the machine doesn't mind and space is saved by avoiding needless repetition. Examples:

.KEC, geography
history
United States

.KUP, number
reading
ability

.KAL, branching
linear
program

.KUP, convergent
divergent
thinking

Another way to express this technique is to say that words connected in normal writing by "and," "or," or a hyphen (e.g. self-selection) will be so connected by the telegraphic abstract when they appear on consecutive lines but share the same role indicator.

When using one role indicator for a group of words, the abstracter must make sure that the function of each word of the group is expressed accurately by the shared role indicator. It is wise practice to reconsider each word recorded on the abstract in relation to the role indicator with which it has been associated, and ask oneself "does the concept expressed by this word really serve the function expressed by its role indicator?" It is also important to examine each group of words that share a role indicator, to make sure it contains no meaningful sub-group or has no alternate meaning. For instance, if the sample given above (KUP, number/reading/ability) had been "music/reading/ability," it would identify its abstract as pertinent to three different topics, i.e. music ability, reading ability, and ability to read music.

The role indicators and punctuation, together with the semantic code through its thesaural function, are the crux of the Western Reserve mechanized information retrieval system. The precision and discrimination provided by role indicators and punctuation become feasible for literature analysis only through the high speed and complexity of computer operation.

If role indicators and punctuation are not exploited fully, consistently and accurately, this computer-based system loses much of its peculiar discriminative power, because efforts to exploit the role indicators and punctuation in searching will be of limited effect. We must be able to require role indicators and punctuation in a search structure, as needed, with assurance that we will not thereby miss any pertinent, or find any nonpertinent, information.

Compound Terms

The following rules govern the decision to write compound terms together or on separate lines:

1. The compound name of a specific concept or device may be written on one line. Examples:

.KAM,	teacher training
.KQJ,	pie graph
.KEJ,	control group
.KEC,	social studies
.KAH,	in service
.KEJ,	student teacher

2. More generic terms for concepts or devices should be written on two lines with the role indicator preceding the first word. Examples:

.KQJ,	audiovisual equipment	.KAB,	research review

.KQJ, teaching
machine

.KEC, foreign
language

.KWV, low
socioeconomic
level

3. The names of specialized techniques should be written on one line. Examples:

.KAM, cross validation
.KAM, creative writing
.KAM, role playing

4. Any compound term which contains a proper noun or a trade name must be written on one line. Examples:

.KQJ, Pearson r
.KQJ, Skinner machine
.KQJ, Minnesota TAI
.KIS, New York University

5. Except for cases such as those given above, only one word should be written on a line. The absence of punctuation and role indicators between the words will group them as a compound word if they are so in function.

A general rule to go by is that phrases of two or more words should be put together on one line only if they connote a specific meaning together that they would not have if thought of separately. (See page 180 for words which should be put together).

Qualifying Data

Specific data from the literature abstracted does not need to be stored for searching purposes, (except date of publication), but is sometimes valuable when the telegraphic abstract is being scanned during evaluation of a search retrieval. Where qualifying data is important, it should be expressed in words or numbers, written immediately after the word qualified, and put in parentheses. (Parentheses will keep it out of the machine). Examples:

.KEJ,	children (30)
.KIS,	large (100) class
.KWV,	adolescent (14-18)
.KAH,	short (½ hour) period

Grade levels are to be expressed under the following categories:

kindergarten	
primary grade	meaning 1-3
intermediate grade	meaning 4-6
junior high	meaning 7-9
senior high	meaning 10-12

Further detail of grade may be given in parentheses.

Format and Style Rules

The following rules are necessitated by the machine operations which lead to the final telegraphic abstract on tape:

1. The abstract is to be printed in ink or typewritten, using captital letters or upper case.
2. The printing should be placed slightly above the line.
3. There should always be a word in the space directly opposite a role indicator.
4. The first role indicator of the abstract must go in Column 1.
5. Words must be spelled correctly, preferably with the first given American spelling.
6. Use no periods or commas. (e.g., "IQ," "NEA," "Madison Wisc")
7. Commonly used abbreviations are allowed. Since processing requirements limit the number of letters which can be recorded from one line, long proper names should also be abbreviated. Use the following pattern where possible: spell out or abbreviate the more

specific aspect of a term and express the more generic part by abbreviation or first letter only, e.g. --
Boston Mass
Otis QSMAT (Quick-Scoring Mental Abilities Test)
Minnesota TAI (Teacher Attitude Inventory)
Indiana Univ
US Naval TDC (Training Devices Center)

8. Nouns which have the verbal ending "ing" are distinguished from the verb by being made plural. Example --
   ..KAM, recording
   .KQJ, recordings

9. Nouns which serve also as adjectival nouns or adjectives are distinguished from the latter by plural ending. Example --
   .KWV, ideal (as adjective)
   .KUP, ideals (in the "standards" sense)

10. Except for cases such as those given above, plural forms are not used.

11. Verbs used with KAM are to be written usually with "ing" or "ion" endings, never in infinitive form.

Word Usage

It is essential that words selected for the telegraphic abstract be both significant and meaningful from the information retrieval point of view. The abstracter should have these questions in mind constantly:

1. Does each word name clearly something which a person concerned with education might want to ask about? (meaningful)
2. Is the person, process, device or attribute represented by each word treated fully enough in the document so that the document does indeed provide information about it which may be useful to one concerned with education? (significant)

These words might be defined, from the information retrieval point of view, in the following way:

significant: indicating something treated with importance in a given context

meaningful: having high information content. (Such words might appear in a conventional index).

Examples of words which are not meaningful enough to be useful for retrieval (you would never find them in a conventional index):

KWV, pattern
KAL, method
KWV, age (use recognized terms of range, instead)
KEJ, sample
KUP, effectiveness (role-indicator KAL does this)
KWV, characteristic

In order to be sure all significant words are recorded, the abstracter should select from the title as well as the text. Sometimes the major topic is mentioned only in the title, while the text "talks around" it.

Control of duplicate meanings for identical words can be achieved by the encoder at the Center,who keeps these words out of the automatic encoding process and selects the proper code "by hand" from a choice of duplicate codes. Among the homonyms that appear in the education literature with more than one meaning are "mass," "motor," "term" and "manual."

In many cases, the second meaning for a word is an imprecise one, for which that word should not be used. Social science literature tends to adapt words which have physical or material meanings for use in a non-physical sense; for example, "climate," "institution" and "atmosphere" are often used to describe the mental-emotional-social aspect of an environment. The opposite sort of adaptation also occurs sometimes, perhaps the result of efforts to emphasize the growing scientific orientation of behavioral sciences; for example, tests are described as "instruments." Where such extended meanings result in ambiguity, their selection as terms for the telegraphic abstract should be avoided.

It is sometimes desirable to "lump" words, as for a piece of literature that names a great many specific devices or topics but does not deal with any one of them very fully. A long list of specific courses, for example, might be represented by more generic terms for curriculum areas, such as "social studies," "foreign language," or "fine arts." Several devices of one class which are each treated only briefly in an article should be described by one generic term in the abstract (e.g. "audiovisual device"); if not, the abstracter will give a misleading impression of how much information the article provides.

The abstracter is asked to cooperate in word control by following the word-usage rules given below and others which will be added from time to time.

Reference

J. W. Perry and Allen Kent, eds., Tools for Machine Literature Searching. New York, Interscience Publishers, Inc., 1958. Particularly Chapter 5, "Procedures for Preparation of Abstracts for Encoding."

WORD CONTROL

Word usage should be controlled in the following ways:

1. Use plural endings to differentiate between nouns and identical verbs or adjectives (see p. 176)
2. Use "record" to mean written record; use "phonograph record" or "recordings" for the audio type.
3. Use "subject" in the information sense, not for a person under study.
4. Use "material" for matter, not in the "course of study" sense.
5. Use "facilities" for equipment, "facility" for skill.
6. Use "objectives" to mean purpose, "objective" for the adjective and "object" to mean thing.
7. Use "writing" for composition, not for handwriting.
8. Use "correspondence" in the communication sense (including correspondence courses) not in the matching relationship sense.
9. Use "culture" in the mores-civilization sense, not in the "education" sense (as "cultural" life of community).
10. Use "institution" in the location sense, not in the "social institution" sense.
11. Use "climate" and "atmosphere" in the physical sense, not in the mental-emotional sense.
12. Save "trainer" for the person; use "training device" for the gadget.
13. Use "instrument" in the mechanical sense, not as a synonym for "test."
14. Use "re-" combined forms sparingly.
15. Nationality adjectives which double as the name of a language:
    a. for language, use the adjective (e.g. KEC, Spanish)
    b. for adjective, use the noun (e.g. KWV, Spain)

COMPOUND TERMS

The following compound terms should be written together on one line:

combinations with proper names, as explained on p. 174.

Overhead projector (and other types)

secondary school (and other types)

reinforcement item (and other teaching machine "items")

motion picture

in progress, in service, in context

very small (groups of people under four in number)

tape recordings or tape recorder

bulletin board, flannel board

construction paper

vidicon camera

trainer tester

social science

expert power (and other types of influence)

follow-up

field study, case study

study hall

student teacher, student teaching

Latin (Spanish) American

self concept, self image

creative writing

master teacher

day care center

phonograph record

school age

product moment correlation

city (,) state

t test

F test

shadow puppet

school board

cross media (and others with "cross")

art column

fine arts

role playing

self assurance

laboratory school

language lab

teacher training

work study

Do not write in this space

Col. 6-8	Role Indicator (Col. 28-80)	Col. 6-8	Description (Col. 9-27)
1	..KAB, (type of literature)	2	RESEARCH
3	.KIS, (location)	4	U OF SOUTHERN CALIF
5	.KQJ, (sponsor)	6	NDEA TITLE 7
7	..KIT, (year)	8	1960
9	..KEJ, (subject of study)	10	STUDENT (558)
11	.KIS,	12	ELEMENTARY SCHOOL
13		14	INTERMEDIATE
15	.KWV, (attribute)	16	IQ
17		18	AGE
19		20	SEX
21		22	SOCIOECONOMIC
23		24	MATCHED
25	.KIS,	26	LOS ANGELES CO CALIF
27	..KAM, (process)	28	TESTING
29	.KQJ KWJ, (means developed)	30	FACT
31		32	CONCEPT
33		34	TEST
35	..KEC, (subject-matter taught)	36	SOCIAL STUDIES
37	.KQJ, (means)	38	FILMSTRIP
39	.KQJ,	40	FILMOGRAPH
41	.KWV,	42	CAPTION
43	.KWV,	44	NARRATION
45	.KWV,	46	SOUND
47	..KAM,	48	DATA
49		50	ANALYSIS

Abstracter ____________

____

Col. 6-8	Role Indicator (Col. 28-80)	Col. 6-8	Description (Col. 9-27)
51	.KQJ,	52	VARIANCE
53	.KQJ,	54	TUKEY TEST
55	..KUP KAP, (finding influenced)	56	IMMEDIATE
57		58	RETAINED
59		60	LEARNING
61	.KAL, (influencing factor)	62	IQ
63	.KAL,	64	SEX
65	.KAL KXL, (sometimes not an influence)	66	CAPTION
67	.KAL KXL,	68	NARRATION
69	.KAL KXL,	70	SOUND
71	.KAL KXL,	72	FILMOGRAPH
73		74	
75		76	
77		78	
79		80	
81		82	
83		84	
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APPENDIX B

PART 3

ORIGINAL DOCUMENT

[184]

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Final Report

Grant No: 7-04-102.00

U.S. OFFICE OF EDUCATION, DEPARTMENT OF HEALTH,
EDUCATION, AND WELFARE

A Comparative Study on the Effectiveness of the Filmstrip, Sound Filmstrip, and Filmograph for Teaching Facts and Concepts

RONALD J. McBEATH
Principal Investigator

The research reported herein was supported by
a grant from the United States Office of Education,
Department of Health, Education, and Welfare.

February 15, 1961

Submitted by
Department of Audio-Visual Education
University of Southern California
Los Angeles, California

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FINAL REPORT

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CHAPTER I

INTRODUCTION

Advances in knowledge in all fields, and especially in science, have increased the instructional task of the classroom teacher. The teacher must have not only a deeper and wider understanding of his subject matter but also the best instructional techniques for its presentation.

Over the past forty years an ever-growing amount of research has been published regarding the effectiveness of various audio-visual media in presenting knowledge. In the area of filmed material many studies have been conducted but none were available comparing the filmograph with filmstrips. The writer felt that a comparative study in this area would show whether the filmograph could be a more effective teaching tool than either the captioned or the sound filmstrip. The filmograph is made by photographing still pictures on motion picture film, using such techniques as camera movement and pop-ons.

An experiment comparing the effectiveness of the filmograph and filmstrips was considered a logical extension to research conducted by Zuckerman (51) and by May and Lumsdaine (16).

Zuckerman, in 1954, reported an attempt to find an economical way to conduct pre-release testing for educational films. From the story board of a film, 262 frames were selected to make a filmstrip. The film was used to familiarize jet pilots with speed limitations and load limits of the F86A. The sound track of the film was recorded on a disc. One hundred and eighty airmen of comparable background experience were randomly assigned to receive instruction by the film and by the filmstrip with the recording. The presentation took place in comparable classrooms and for the same amount of time. A twenty-six-item multiple-choice test was given to check gains in knowledge.

There was no statistically significant difference between the effectiveness of the media, hence Zuckerman concluded that the filmstrip could be used to reliably predict the effectiveness of the film.

The study reported by May and Lumsdaine (16:18), in 1958, compared a film with a film of the story board. The pencil sketches selected from the story board were photographed on 16mm motion picture film. The narration of the film was put on a sound track to accompany the filmed pencil sketches. This type of production is very similar to a filmograph.

Four classes of fifth grade pupils were subjects in the experiment. They were randomly divided into halves, and while one half saw the film, the other half continued with regular school work. After seeing the film, the first group of students took a ninety-one-item test, while the other half saw the pencil-sketch version. Both groups were allowed as much time as they needed, about twenty minutes, to finish the test.

A random selection of fifty pupils in each group was made for convenience of analysis. No pre-test was given, but it was assumed that, due to randomizing, the groups were insured for substantial initial equality. A comparison of the mean scores showed that there was no significant difference in learning between the crude pencil-test and the polished final film.

In their evaluation of the study, May and Lumsdaine noted that, besides the major variable involved, there were others which might have influenced the results. They concluded that, for teaching the kind of material important in understanding seasonal changes, a crude presentation such as the pencil-test film can teach at least as well as a polished color-film costing ten times as much.

It was partly the results and suggestions of these two studies which led to the present investigation and formulation of the statement of the objectives of this research.

The Problem

It was the purpose of this study to compare the relative effectiveness of four filmic methods of presenting facts and concepts. The four filmic methods were:

1. Captioned filmstrip.
2. Captioned filmstrip with narration.
3. Sound filmstrip.
4. Filmograph.

The study attempted to answer the following questions with equivalent groups of students who were required to perform on a post-test given immediately after the presentation and on a retention-test given three weeks later:

1. Is one method superior or inferior to the other methods?
2. Do boys learn better from the media than girls?
3. Do students with a higher intelligence quotient learn better than those with a lower intelligence quotient?

The study attempted to verify the hypothesis that the filmograph could teach more effectively than the other media.

CHAPTER II

METHOD OF PROCEDURE

A design for the experiment was formed and put into operation so that maximum control could be maintained. The following outlines the order of procedure:

1. Production of filmstrips and filmograph.
2. Preparation of testing instruments.
3. Selection of experimental population.
4. Pilot study to refine testing instruments and procedures.
5. Administration of the experiment.
6. Assembling of the data.
7. Statistical analysis of the data.

The steps outlined above will now be discussed more fully.

Production of Filmstrips and Filmograph

The content was directed towards sixth grade social studies. A script was developed around the exodus of the Maoris from Polynesia, their sea voyage to New Zealand, and their way of life in New Zealand before and after the arrival of the white settlers. It was decided to limit the filmograph to a 400' reel and the filmstrips to seventy-two frames as this is the usual length of materials at the sixth grade level. A breakdown of the script into the major parts was made and the essential facts were selected. The exacting process of expressing the essential facts in an interesting caption and picture was begun. An arbitrary limit of four new facts was set for each caption and a determined attempt was made to work well within this limitation. A significant guide to the content of each caption was obtained while developing seventy multiple-choice questions.

The sketches were drawn so that they would contribute to the students' knowledge by presenting relevant cues and not inhibit learning through distracting cues. Care was taken so that the pictorial element was not deficient in detail, definition, or clarity. Refinements and revisions were made of both verbal and pictorial statements following advice given to the producer by experts at the University of Southern California and audio-visual directors in Los Angeles City and County.

The finished art work was done with a black felt-tipped pen, shadows and perspective being achieved through water-color washes and dry-brush technique. Retouching of the art work for photographing was done by a professional artist.

The filmstrip with and the filmstrip without captions were photographed in the usual double frame technique on 35mm film. The captions were limited to three lines of black print on white background at the bottom of each frame on the captioned filmstrip. No captions were included on the sound filmstrip. Filming of the filmograph was completed on an animation stand in the Cinema Department of the University of Southern California. The sound track of the filmograph was duplicated for use with the sound filmstrip except that an audible tone was added at those points where the filmstrip should be turned on to the next frame.

The sound track for the captioned filmstrip with narration was recorded. The words in the caption were read with clear enunciation and a period of about four seconds was allowed between captions. Since the war dance section was not printed a minor media difference was created. In the sound filmstrip the students hear the chant but in the captioned filmstrip they are told that the Maoris chanted a war dance and made frightening faces.

Preparation of Testing Instruments

Seventy questions were designed for facts and concepts in the cognitive area rather than the effective area of behavior. The cognitive areas of knowledge as outlined by Bloom (3) were used as a guide when making the test. The division was:

1. Specifics.
2. Terminology.
3. Specific facts.
4. Conventions.
5. Trends and sequences.
6. Principles and generalizations.
7. Theories and structures.

Care was taken to see that the questions did not cue each other and that none of the four possible choices in each question was obviously correct or incorrect. The questions were related to the words and picture in each frame of the filmstrip.

Sixty questions were chosen from the original seventy and used in a pilot study on 135 children comparable to those in the experimental group.

Selection of the Experimental Population

The superintendents of schools in the East Whittier, Montebello, and Whittier City districts in Los Angeles County, California, gave permission for the study to be carried out in their schools. Twenty sixth-grade classrooms were selected from ten different areas in order to have students of varying socio-economic status.

Upon the recommendation of the superintendent, the schools made the cumulative records available so that intelligence quotient, age, sex, and father's occupation could be recorded for each student. This information was kept confidential and students' names and the names of the schools were omitted from the tables tabulating the results. The students involved had all been given the California Test for Mental Maturity within a period of nine months prior to the study.

The socio-economic status of the students was determined by using a scale reported by Warner (22:140). Warner based his rating on the occupational status of the father. The scale was divided into seven categories. In some isolated cases approximations had to be made since the students were not certain of their father's occupation.

When matching the students into four groups, IQ, age, sex, and socio-economic status were considered. The matching was done so that there were five classes in each group and the total number of boys and girls in each group was approximately the same. In only one instance was it necessary to have two classes from the one school in the same group.

The investigator noted that there were extremes in IQ and checked with the classroom teachers regarding any children who had extreme reading difficulty or language difficulty. The scores of these few children were not included in the statistical analysis.

The Pilot Study

Procedures for presenting the four media were checked in the pilot study and the reliability of the test was found to be .85, using the Kuder-Richardson formula 20. An item analysis, for difficulty and discrimination enabled two equivalent forms of thirty questions each to be constructed by pairing questions for subject matter, difficulty and discrimination.

Administration of the Experiment

A survey of the viewing conditions was made so that all students could see and hear the presentations with comparable ease. In each school the presentation was made in the room customarily used for projection. Equipment was checked and the same pieces used throughout the experiment.

The experiment was begun after the usual schoolday preliminaries were completed. The teacher introduced the investigator as having come from the district office to conduct an experiment. The investigator played a tape so that each class had the same introduction. The students heard that, just as manufacturers test their products to make refinements, so do the makers of films and filmstrips. They then heard how they could help in the study; that the material was about the Maoris of New Zealand, and their way of life before and after the arrival of the white settlers. The students were then told that they would have a test to see how much they already knew and that, after seeing the presentation, they would have a different test from the results of which the investigator could tell how well they had been taught by the materials. To help prevent unnecessary anxiety, the students were told that the results would not appear on their final reports, but that they would be made known to them by their teacher.

The pre-test was distributed so that students sitting beside each other had different forms of the test. Reading books were left accessible by the students so that they would not be idle after completing the test. No time limit was placed on the students and the instructions printed on the front page of the test required them to answer all the questions and mark only one choice in each question. After the completion of the pre-test--about fifteen minutes--the room was darkened for projection or the students were taken to the projection room.

The presentation completed, the students were given the alternate form for the post-test. The testing and presentation were all completed within an undivided hour. The teacher was asked not to tell the students that there would be a retention-test and was requested not to encourage discussion regarding the content.

Three weeks later the retention-test was administered. For this test both forms were stapled together to make a sixty-question test. Students sitting beside each other began work on a different form. This was considered to be an added precaution against copying.

Assembling the Data

The tests were hand scored since separate answer sheets were not used. The total scores from the three tests, showing which form they had been scored on, were entered on a ledger sheet together with the IQ, age, socio-economic status, and sex of the students. The gains from the pre-test to the post-test and from the pre-test to the halved retention-test score were also recorded on the form.

Statistical Analysis

The data were statistically treated to show test reliability, population matching and whether there were any significant differences in learning from the media. The statistical treatment of the test scores was focussed on the mean gain between the pre-test and the post-test and then the mean gain between the pre-test and retention-test. A method was sought which would allow all of the mean gains within each series of tests to be tested for significance. The analysis of variance (7:315) and the corresponding test for significance based upon the F distribution permitted this to be done.

If the F test shows there is a significant variance among a group containing more than two means, then a further test is needed to find whether there is a significant difference between any one mean and any other mean.

It was decided to use the Tukey test (7:331) if a significant variance was found. The Tukey test for significant gap between adjacent rank ordered means shows whether any one mean is significantly superior or inferior to the others.

The Tukey test is applied by taking t at some defined level of significance, for example, at the 5 per cent level, for the degree of freedom available and then solving for

$$\text{Significant gap} = (t_{.05})(\sqrt{2})(S_{\bar{x}})$$

Where $S_{\bar{x}}$ is defined as by the formula

$$S_{\bar{x}} = \frac{S}{\sqrt{n}}$$

and $t_{.05}$ is the tabled value of t at the .05 level for the degrees of freedom associated with the mean square within groups.

The t test of individual means was not applied to test findings after the analysis of variance showed a significant F ratio, since it involves the hypothesis that the samples have been drawn at random from a common population (10:264). When making a t test of two extreme means, however, the two sample means have not been selected at random for comparison.

CHAPTER III

PRINCIPAL FINDINGS

The four media were presented and tests given to equivalent groups of students under comparable conditions. The findings on the reliability of the testing instruments, matching of the population, and gains in knowledge from the media presentations follow.

Test Reliability

The reliability of each test was calculated by the internal consistency method. The Kuder-Richardson formula 20 was used for the pre-test and the Kuder-Richardson 21 was used on the post-test and retention-test. Since the number of items in the post-test was thirty, whereas the number of items used in the other tests was sixty, the Spearman Brown formula (10:492) was used to adjust the estimated reliability for purposes of comparison. The pre-test reliability was .85, the post-test reliability was .72, and the retention-test reliability was .75.

The Population

The four groups were matched on the basis of age, IQ, and socio-economic status. As may be seen in Table 1, there were no statistically significant differences between the groups using these criteria. The four groups may be considered as equivalent. The population was regrouped according to sex for age and IQ differences. The boys' mean age was one month greater than the girls' and this was significant at the .01 level. A one point difference between the mean IQ of the boys and girls was not significant. The mean IQ of 110 may be slightly higher than that of the general population.

TABLE 1

MEANS AND STANDARD DEVIATIONS OF THE MATCHED GROUPS FOR AGE, INTELLIGENCE QUOTIENT, SOCIO-ECONOMIC STATUS, AND SEX

Variable	Group	N	Mean	S.D.
Age	C	138	137.34	5.39
	CN	144	138.19	4.39
	F	138	138.29	4.99
	SF	138	137.92	5.07
	t = 1.52		df 274	NS
IQ	C	138	111.62	14.04
	CN	144	110.18	15.48
	F	138	109.98	15.78
	SF	138	109.91	15.48
	t = 0.96		df 280	NS
Socio-Economic Status	C	138	3.59	1.57
	CN	144	3.54	1.62
	F	138	3.52	1.57
	SF	138	3.59	1.63
	t = 0.34		df 274	NS
Age	Boys	294	138.49	5.30
	Girls	264	137.33	4.52
	t = 2.75		df 556	p<.01
IQ	Boys	294	110.89	16.18
	Girls	264	109.89	14.07
	t = 0.77		df 556	NS

The population was also redivided into three IQ levels. The students were divided into the top third, middle third, and lower third according to their intelligence quotient. The means were 127, 109, and 94 respectively.

Test Results

The students did learn by each of the four methods. After establishing an average of eleven plus on the pre-test, the students averaged twenty-three plus on the post-test. These results were achieved on a thirty-item test made up of four choice questions.

Immediate mean gains

Comparison of the four methods.--The mean for each of the twenty-four subgroups and the average mean for each of the methods may be seen in Table 2. The difference between the four method gains of 12.25, 12.28, 11.23, and 11.76 was statistically significant at the .05 level of confidence in the analysis of variance. The Tukey test for significant gap, when applied to the rank ordered means, showed that no one method was significantly superior or inferior despite the fact that there was significant variance among the four means.

TABLE 2

MEAN GAINS BETWEEN PRE-TEST AND POST-TEST FOR THE FOUR METHODS AT THE THREE INTELLIGENCE QUOTIENT LEVELS BY SEX

Sex	Level	Method C	Method CN	Method F	Method SF
Boys	Upper	13.04	13.04	12.87	11.72
	Middle	13.04	13.60	12.22	11.52
	Lower	11.80	11.76	11.17	11.00
Girls	Upper	13.05	14.26	11.44	12.81
	Middle	11.00	10.74	10.69	12.48
	Lower	11.33	10.13	9.00	11.24
Means by Methods		12.25	12.28	11.23	11.76

Average Mean Gain = 11.88

Comparison of male and female.--The difference between the boys' mean gain of 12.24 and the girls' of 11.49 was significant at the .01 level. This may have been due to the slightly older age of the boys or the subject matter may have been more appealing to boys.

Comparison of intelligence levels.--The mean gain of the upper third was 12.77, of the middle third 11.94, and of the lower third 10.94. The analysis of variance showed the difference was significant at the .05 level. In each case the brighter students learned more.

Interaction between sex and methods.--In Table 3 a breakdown of the mean gains of boys and girls according to the methods shows that the highest mean gain of 12.80 was scored by the boys who saw the captioned filmstrip with narration and the lowest of 10.37 was gained by the girls who saw the filmograph. The trend was for the girls to achieve smaller mean gains than the boys, except in the case of the sound filmstrip where a reversal took place. After the effects of the variables of sex and methods were removed, in accord with a method noted by Guilford (10:276), the pattern observed in the raw score mean gains is more clearly shown. The variance among the boys' scores was smaller than the variance among the girls' scores. The results of the analysis of variance indicated, at the .05 level, that some of the variance in learning scores is dependent on the interaction of methods and sex.

There was no significant difference in the interaction between levels and methods or the interaction between sex and levels.

TABLE 3

MEAN GAINS BETWEEN PRE-TEST AND POST-TEST AND ADJUSTED MEAN GAINS WITH VARIABLES REMOVED FOR THE FOUR METHODS BY SEX

Sex	Methods				Average Mean of each Sex
	C	CN	F	SF	
			Mean Gains		
Boys	12.63	12.80	12.09	11.41	12.24
Girls	11.79	11.71	10.37	12.18	11.49
			Adjusted Mean Gains		
Boys	11.91	12.04	12.35	11.11	11.85
Girls	11.82	11.69	11.38	12.62	11.85
Average Mean of Methods	11.85	11.85	11.85	11.85	11.85[a]

[a]Allowance being made for rounding errors.

The results of the analysis of variance for the immediate gain are shown in Table 4.

TABLE 4

ANALYSIS OF VARIANCE ON THE MEAN GAIN
BETWEEN PRE-TEST AND POST-TEST

Source	Sum of Squares	df[a]	Mean Square	F	P
Total	1890.43	557	--	--	--
Within	6111.45	534	11.44	--	--
Methods	101.23	3	33.74	2.95	.05
Sex	76.64	1	76.64	6.69	.01
IQ Levels	311.67	2	155.84	4.62	.05
Sex and Methods	110.55	3	36.85	3.21	.05
Levels and Methods	39.10	6	6.52	0.57	--
Sex and Levels	67.58	2	33.79	2.95	--

[a] df = degrees of freedom

Note:

The triple interaction was in no case significant.

Retention mean gain

Comparison of the four methods.--The mean gains of the twenty-four subgroups and the average mean for each method are shown in Table 5. The analysis of variance showed that there was no significant difference between the mean gains for each group of 7.83, 8.39, 7.76, and 7.64. Although the subgroups changed to some extent in their rank order, the groups which scored the greatest and least mean gains maintained their respective positions. The difference between the highest and lowest subgroups in the immediate gain was 3.50 points. In the retention gain this difference was extended to 4.52 points.

TABLE 5

MEAN GAINS BETWEEN PRE-TEST AND RETENTION TEST FOR THE FOUR METHODS AT THE THREE INTELLIGENCE QUOTIENT LEVELS BY SEX

Sex	Level	Method			
		C	CN	F	SF
Boys	Upper	8.88	10.10	9.57	7.48
	Middle	8.54	9.18	9.07	7.64
	Lower	7.28	7.48	6.46	6.84
Girls	Upper	8.59	10.57	7.94	8.86
	Middle	7.00	6.61	7.50	8.52
	Lower	6.45	6.26	6.04	6.67
Means by Methods		7.83	8.39	7.76	7.64
	Average Mean Gain = 7.91				

Comparison of male and female.--The average mean gain for the boys was 8.21 and for the girls 7.58. The analysis of variance showed this difference to be significant at the .01 level. This is a similar result to the immediate mean gain.

Comparison of intelligence levels.--The mean gain for the three groupings shows the score of the upper third to be 8.99, the middle third 8.03, and the lower third 6.70. The difference is significant at the .01 level.

There were no significant differences among the interactions between sex and methods, levels and methods, or sex and levels.

The results of the analysis of variance on the retention mean gains are shown in Table 6.

TABLE 6

ANALYSIS OF VARIANCE ON THE MEAN GAIN
BETWEEN PRE-TEST AND RETENTION-TEST

Source	Sum of Squares	df[a]	Mean Square	F	P
Total	6707.43	557	--	--	--
Within	5843.10	534	10.94	--	--
Methods	47.22	3	15.74	1.44	--
Sex	54.55	1	54.55	4.69	.01
IQ Levels	492.83	2	246.41	22.52	.01
Sex and Methods	82.87	3	27.62	2.52	--
Levels and Methods	97.26	6	16.21	1.48	--
Sex and Levels	34.13	2	17.07	1.56	--

[a] df = degrees of freedom

Note:

The triple interaction was in no case significant.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Statement of the problem

The purpose of this study, as stated in the first chapter, was to compare the relative effectiveness on factual learning of: (1) a captioned filmstrip, (2) a captioned filmstrip with narration, (3) a sound filmstrip, and (4) a filmograph. The study attempted to verify the hypothesis that the filmograph, being more polished and a more complete package, could teach more effectively.

No studies of the same nature were found in the available literature, but some studies were located which compared films with filmstrips and films with filmographs. The findings generally showed that there was no significant difference between the effectiveness of the media studied.

Method of procedure

From a population of 558 sixth-grade students in Los Angeles County, California, four matched groups of approximately the same size were formed. The students were matched for intelligence quotient, age, sex, and socio-economic status. The matching was done so that there would be five classes in each group.

After the materials had been produced and the tests made, a pilot study was conducted so that any necessary refinements on the tests and procedures could be made.

The experiment was administered so that the students in each class had a pre-test, saw the presentation, and then had a post-test, all within an hour. The experiment took two weeks and each class was given a retention-test after a three-week period. The data were recorded and from the data statistical evidence of the matching of the groups and reliability of the tests was established. An analysis of variance was conducted and Tukey tests were made on the four methods.

Findings

The statistical evidence showed the groups were sufficiently well-matched and the tests reliable enough to make competent analysis of the results.

Analysis of variance on the mean gain between pre-test and post-test

1. There was a significant difference between the methods, but the Tukey test on the rank ordered means revealed that no one method could be considered significantly superior or inferior.
2. The boys did significantly better than the girls.
3. Students with a higher intelligence quotient did significantly better than those with lower intelligence quotients.
4. The interaction between sex and methods was significant.

Analysis of variance on the mean gain between pre-test and retention-test

1. There was no significant difference between the four methods.
2. The boys were significantly better than the girls.
3. The students with the higher intelligence quotients did significantly better than the students with the lower intelligence quotients.
4. No interactions were significant.

Conclusions

The hypothesis that the filmograph can teach better than the filmstrip is rejected. Matched groups of students can apparently learn equally well from captioned filmstrip, captioned filmstrip with narration, sound filmstrip, and filmograph. This was found to be the case on the immediate post-test and on the retention-test given three weeks later.

It would appear from this study that having such media differences as musical background, panning, pop-on words, and other filmic techniques has no measurable effect on learning. However, it should be remembered that the specific effects used within each medium were not separated for testing purposes. Each of the media was designed to convey the same content using the same pictures and words.

The effects used were those which were considered as being peculiar to each medium and contributing to its general effectiveness. It is possible that some of the effects used within each of the media cancelled out other effects. It is also possible that some students learn more effectively from one medium than from another. It is difficult to conclude how much of the learning achieved in this study may have been influenced by any one, or a combination, of several factors such as motivation from the subject matter content, the presence of a stranger in the classroom, the interest of a different activity, and the importance and competitiveness in taking part in an experiment. Perhaps when these conditions exist, any presentation made in a clear and competent manner will produce results showing no significant superiority or inferiority of any one medium.

The findings of this study tend to support previous research regarding media effectiveness. It is important to realize that any of the media, when used efficiently, will improve the learning situation. Efficient use depends entirely on the classroom teacher. The teacher must decide which medium is likely to most effectively meet the needs of the particular situation.

In a study such as this, consideration must be given to the limitations of subject matter, the type of questions asked, and the size and nature of the sample, when drawing conclusions. This study was made with sixth-grade children and different results may have been obtained with children in lower or higher grades. The conclusions mentioned apply only to the students presented with the materials under the conditions of this study. Repetition, using different subject matter or different grade levels, might result in different conclusions.

Recommendations

If quantity and quality are to be continually sought in the teaching-learning situation, it is important for specific research to continue to seek ways of improving instruction and instructional techniques. This study covers a limited area, but even so, it opens avenues for more studies to follow.

Further investigation is required in such areas as the types of sound tracks, length of materials, and the use of materials for optimum effect. Perhaps the most pressing need is the development of new types of testing devices, as a paper and pencil test is possibly limiting after a visual and auditory presentation.

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APPENDIX C

TERMINOLOGY CONTROL

PART 1 - THE SEMANTIC CODE: MANUAL FOR ENCODERS

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APPENDIX C

PART 1

THE SEMANTIC CODE: MANUAL FOR ENCODERS

THE SEMANTIC CODE: MANUAL FOR ENCODERS

The Center for Documentation and Communication Research of the School of Library Science of Western Reserve University acquires current literature in metallurgy and related sciences, several branches of medical science, and education. Two types of abstracts are made from pertinent articles and documents. One, the conventional abstract, is a paragraph written to indicate the basic contents and emphasis of the original. The other, the telegraphic abstract, is an index of selected key words from the document which are stored in the literature searching machine to provide for future access to the information.

The English terms in the index-style abstract must be converted to a system of meaningful markings on magnetic tape so that the concepts they express can be stored and retrieved by machine. The first step in this conversion is the translation of the English terms into the semantic code. The subject of this Manual is the way in which the semantic code is created and used as a basic tool in the machine literature searching procedure.

The code is made up of symbols (four-letter factors and related numbers) which:

1) express the generic and/or specific concept or concepts which the English term represents;

2) relate the term to other terms representing some or all of the same concepts.

Each code may most helpfully be thought of as an entry in a kind of thesaurus, through which concepts sharing certain generic characteristics are indicated as having those characteristics in common. By this means, concepts may be shown as possessing certain generic concepts in common with one group of concepts, and at the same time be shown as possessing certain other generic concepts in common with quite another group of concepts. Such grouping is extremely flexible, permitting a considerably wider range of searching than would be possible with a classification system, a conventional indexing system, a dictionary, or a conventional code.

The semantic code, then, is a device which, when combined with the telegraphic abstracting system, will enable a subject to be searched, by machine processes, for information either explicit or implicit in the recorded body of material.

As an example, consider two teaching machines, the Osler machine and the visitutor. The semantic codes for these terms are as follows:

Osler machine	MACH PQTG SUCH 3564
visitutor	MACH PQTG SUCH 3576

The semantic factors chosen to express the important concepts in this class of teaching machines are interpreted to mean:

MACH	device
PQTG	by means of a film
SUCH	used for teaching

The two specific teaching machines are differentiated by having different numbers at the end.

Over 50 different teaching machines have been noted in the education literature so far. The English terms for these are inconsistent and fail to show the relationship that exists between members of the group. English terms, therefore, are not suitable for machine searching purposes. The semantic code, however, clearly expresses the relationship between these devices by using the same two semantic factors (MACH and SUCH) for each one, identifying subgroups by one or two significant additional factors (in the case above, PQTG), and specifying individual devices within these groups by individual end numbers. Converted to code and recorded on tape, the concepts can be retrieved individually or all together, as desired. Thus, a document giving information about the visitutor is available as a reference to general questions about teaching machines which use filmed material. But it is also accessible alone, as a response to a specific question about the visitutor as such (MACH PQTG SUCH 3576).

Before learning the procedures involved in developing semantic codes, it will be helpful to understand the nomenclature which will be used in this paper.

Semantic code: the entire semantic code system. Individually encoded concepts will be referred to simply as "codes."

Code: the individual semantic code used to represent an individual concept. An example is the code for "Osler machine," shown above.

Concept: the real, imaginary, or abstract existence which is represented in language by a word or combination of words. "Osler machine," for example, is not in itself anything but a group of marks which for English-speaking people represent a certain combination of sounds. This combination of sounds, in turn, represents a device which is used for teaching and makes use of filmed material. This concept is the real existence of which the words "Osler machine" are only a symbol twice removed. One who works with the semantic code must always remember that the concept, not the word, is the reality with which he is primarily concerned.

Word: the symbol, expressed in written English, for a concept. It should be noted that word may be applied to units conventionally thought of as multiples, when these units express a single concept. Thus, "Osler machine," while two words in conventional terminology, is thought of as one word here, since it expresses a single concept.

Semantic factor: the separate unit of a code, expressed by three consonants. In MACH PQTG SUCH 3576 the semantic factors are: M-CH (device), P-TG (photograph) and S-CH (education). Each semantic factor represents one of a number of highly generic concepts; together they form, as it were, the building-blocks of the code. It should be noted that within a code composed of more than one semantic factor, the separate semantic factors are arranged alphabetically, ignoring the infixes.

Infix: certain symbols used with the semantic factors in a code. In the example above, the infixes are A, Q and U.

Alphabetic infix: the second letter in each semantic factor. It shows the analytic relationship of the semantic factor in which it appears to the concept represented by the code. (Refer to pages 232- 233.)

Numerical infix: the numeral following some semantic factors. It shows, where used, a degree of particularization in the semantic factor to which it is affixed. (Actually every semantic factor possesses a numerical infix. Where a factor appears in a code without a numerical infix, the generic infix 1001 is implied).

Numerical suffix: the number assigned each individual code to distinguish it from other codes which contain the same semantic factors and represent similar but not identical concepts.

End number: the informal term used for the numerical suffix.

Telegraphic abstract: the index-style abstract developed for machine searching procedures. It is fully discussed in the manual for telegraphic abstracters.

Role indicator: the symbol prefixed to each word or phrase in the telegraphic abstract. It is linked to the word or words after they have been translated into code. It shows the relationship of the concept represented by the word or code to the neighboring concepts and/or to the idea developed by the subject material. Its full use is discussed in the manual for telegraphic abstracters.

Conventional abstract: the English-language abstract, in paragraph form, of a document, such as an article, report, or monograph.

Encoding: the assignment of a code to the concept represented by a word. The process is automatic except where a code for the word does not yet exist in the code dictionary.

Code dictionary: the complete list of all words and the codes which have been assigned to the concepts represented by those words.

Reverse code dictionary: a code dictionary arranged alphabetically according to the semantic factors contained in each code. The codes are followed by the words for the concepts represented by the codes. The reverse dictionary most clearly illustrates the thesaural principle underlying the code.

Card: an IBM punched card.

Listing: a printed list of the words which failed to match with the card file dictionary in the automatic encoding process.

Block: a group of about 100 abstracts. Blocks are designated by numbers and/or letters.

Preliminary Procedures

After telegraphic abstracts are edited, they are gathered into blocks and numbered accordingly. Then they go to the keypunching department where the words listed on the abstracts and their accompanying role indicators are punched on separate sets of IBM cards. The word cards are sorted alphabetically and are matched by machine against a card file representing the code dictionary. In every block there are several cards which do not match; these are sent to the encoder.

When the encoder receives the listing he looks through it for obvious punching errors and misspellings. Most of these may be determined easily. Sometimes, however, a word is mispunched or misspelled in such a way as to make another word.

Where the error makes a plausible word which is not in the dictionary, it will, of course, be on the listing and the encoder has a chance to catch it. Such words are often noticed as words unlikely in the context of the listing. The coder should always be alert for words which strike him as unusual for the subject field with which he is working. He can verify the word by checking the abstract or, if necessary, the subject document.

When a keypunching or spelling error is discovered, it should be corrected either by clearly changing the printed word or by crossing it out and writing the proper word in the space to the right.

Compound Terms

The encoder must also look for phrases which should be separated into two or more parts. Whether or not a term should be divided before encoding is perhaps the most vexing decision the encoder faces. If the telegraphic abstracters are making good abstracts, and if there is rapport between the editors and the encoders, the problem does not arise too often.

In general, it may be said that in any instance in which the term, if divided, would result in meaningless words, that term may not be divided. An obvious example of this is that a proper adjective used as the name of a device or process cannot be separated from the device or process, e.g., Skinner machine, Tukey test. On the other hand, if by division the new words will not only be individually meaningful but carry exactly the same meaning separately as they did in combination, they should be divided. An obvious corollary is that even though the separated words would be meaningful, separation must be avoided if it results in one, both, or all words having a quite different meaning from that which they have in combination.

In general, the encoder should avoid so far as possible the proliferation of compound words in the dictionary. The existence of both a single code and a pair of separate codes for the same concept complicates the information retrieval procedure.

Once more, the problem here may be mitigated by careful abstracting and editing. It is difficult, however, to banish it completely before the encoder gets the listing. As a final check on compound words, the coder should consult the appended list of accepted compounds.

Variant Forms

Each word on the listing is checked against the dictionary. Where it is discovered that the word is already in the dictionary, this is noted on the listing. Where a different form of the same word, or the same modified by inflectional endings, is discovered, its code, modified if necessary, is supplied.

With the code dictionary containing the number of words it has at the present time, it is probable that a number of words in any listing will already be in the dictionary under different forms, or with different inflections, prefixes, or suffixes. Also at times a word is in the dictionary but simply failed to match; or it did not match either because incorrectly punched or spelled; or, finally, word groups may have been separated by the coder, and one or more of the "new" words may be in the dictionary. For these reasons it has been found worthwhile to check each wor on the listing against the dictionary.

When it is determined that the word should have matched, or that the word, as corrected, will match, the phrase "in dict" is written following the word. The code is not supplied, since this might result in a duplicate dictionary card being processed.

If the word is an abbreviation, for instance "TV" or a variant spelling, for instance "programming," it will be proper here to look for the full word, "television," or the alternate spelling, "programing." The encoder should also consider the possibility that the concept represented by the word may appear in the dictionary in a slightly different form; for instance, the listing may show "Stanford Binet," which appears in the dictionary as "Stanford Binet test."

If it is determined that the listed word does exist in the dictionary in a slightly different form, the code for the form in the dictionary is copied without change into the space in the listing following the new form. This is not to be done, however, for word forms which can be expected to appear only rarely. Examples are the comparative and superlative endings, "er" and "est," and the adverbial ending "-ly," which are not ordinarily used on the telegraphic abstract. In such cases the encoder replaces the listed word with an acceptable form which is an adequate substitute. (Adverbs are replaced with adjectives).

The other class of words which may be discovered in this visual matching of the dictionary is those which are differentiated from words already in the dictionary by inflectional endings or suffixes such as "s," "-ed," "-tion," and "-ing." For words such as these, new codes must usually be developed which will closely resemble the codes already in the dictionary, usually differing only in alphabetical infixes. The semantic factors, the numerical infixes, and the suffixes remain the same.

Naturally, each word must be considered on its own merits, since all inflectional endings and suffixes do not always affect different concepts in the same way. However, there are certain generalizations which may be made. (Before proceeding, the reader should study the list of alphabetical infixes on pages 232-233.).

Plural forms, while their use in abstracts is discouraged, sometimes creep through. Usually when this happens the word is to be corrected as a misspelling. Sometimes, however, it may be felt advisable to keep the plural form, as to distinguish between a noun and a present participle, e.g., "buildings" and "building" or to distinguish between a noun and an adjective, e.g. periodicals and periodical. Except for such cases, the new word is treated as an exact synonym of the old, since there is no significant difference, from the point of view of searching procedures, between singulars and plurals. The code for the form already in the dictionary is entered after the new word on the listing.

Words appearing with the prefixes "pre-" and "re-" can also usually be treated as misspellings; that is, the prefix is crossed out. Where the prefix gives the word a distinct meaning, as in "preadolescent" or "reproduction," the new code should usually have the same factors and infixes as the code for the root word but should be given its own end number. Combined forms with "quasi," "semi," "multi," and "pseudo" are usually divided into two words, since these prefixes have individual codes.

The various verb forms are distinguished by the use of the alphabetical infix. The codes for verbals usually include as an important semantic factor one which implies action of some kind, for example C-MT (direct communication) or S-CH (education). An "-ed" ending on a word informs us that the action implied by the word has been completed; hence the infix in the action factor is usually a "W" for this ending. The infinitive form is not used as a verb on telegraphic abstracts; when it appears on the listing it is to be treated as a noun (e.g. help) and the action factor in its code given the infix A. Another common inflectional suffix for verbs is "-ing." Such endings are generally indicated in the code by using U as the infix in the action factor, since U implies action in itself, and "-ing" frequently indicates continuing action. When the suffix "ings" appears on the listing it can be assumed that it is used on the telegraphic abstract as a noun, and the action factor should be given the infix A.

Generally, the other endings such as "-ivity," and "-bility," and so on, will require an additional semantic factor--usually G-PR (general property). Whenever such a semantic factor is added, the encoder must make certain that the other factors are left, so that a generic search on the factors of the already encoded form will also bring out the new word.

New Words

The encoder determines the meaning of each word left on the listing after the previous processes have been completed. It is always wise to check these words carefully, since a casual inspection of the word will sometimes suggest a meaning which is not actually that intended in the subject material. Also, even in a single field, a writer may use a familiar word in a sense not previously noted for that word. If either of these situations occurs with a word which is already in the dictionary, the new meaning will, of course, not come to the attention of the encoder. (It is to be hoped that he will become aware, before too long, of this new meaning, and will add the proper code to the dictionary). Fortunately, such occurrences are rare.

When an unfamiliar word appears on a listing, the encoder should turn first to a dictionary specializing in the subject field from which the listing was derived. If the word is not found here, other dictionaries should be tried. If still unsuccessful, the abstract and the original material should be examined to determine from that context the meaning of the word. If this fails, the encoder can always fall back on the last resort--asking someone.

When the encoder decides that a new code must be made he must then determine what generic aspects of the concept represented by the word are most important in the light of the subject matter and of searching requirements. Semantic factors and infixes are assigned accordingly.

This is the most important and most difficult step in encoding. Again, no definite rules can be given, and the encoder must be guided by his knowledge of the subject, of the searching procedure, and of the possible questions to be asked.

The encoder's first step is to think of possible synonyms for the word being worked on. Such synonyms may already have been noted in a dictionary or glossary during the preceding operation. If a synonym does exist--for example "Skinner concept" and "Skinner theory," or "school board" and "board of education,"--look up the synonym in the code dictionary. If it is there, copy the code, with infixes and suffix, into the listing following the new word. If there is no synonym in the dictionary, but the encoder is aware that a synonym does exist which is valid and likely to be used in the future, he should add it to the listing and give it an identical code. This will eliminate the risk of error should the synonym be used later.

If no synonym is known or discovered, the next step is to think of words which represent concepts closely related to the concept of the word being encoded. These are then investigated in the dictionary. If found, the same semantic factors and numerical infixes should be used for the new word. The same alphabetical infixes should also be used if they express the proper relationships for the new word too. However, a new end number should be assigned.

If the encoder is unable to discover any already encoded words closely related to the new word, he must create a new code. The procedure here is as follows:

The encoder chooses the proper semantic factors. This is more easily said than done. Many points must be taken into consideration. The first and most important of these is that the code is not intended to classify or to define the word. It is intended to identify it, so that it may become available in the machine-searching procedure. Furthermore, the code will not stand alone. It will be accompanied by a role indicator, and it will be included in the context of a telegraphic abstract. The factors selected, therefore, must be those which will provide a useful code.

The next point to consider is what may be called the "depth" of the code: how many semantic factors are to be used. In order to be handled on conventional IBM cards, a code cannot have more than four semantic factors. Clearly, the more semantic factors used, the more specific will be the identification of the word, and the more opportunities for identifying the concept in the searching procedure there will be. In actual practice, however, the longest code is not necessarily the most useful.

Another consideration is that the numerical infixes, which can be extremely useful in a code, actually represent the end numbers of single-factor codes. This means that no multiple-factor code can ever be exactly identified within the body of a longer code. The same semantic factors may be used, thereby opening the code to a generic search; but the specific idea represented by the multiple-semantic-factor code cannot be shown. For this reason, any concept which is very likely to be required as a sub-concept of other concepts, should whenever possible be given a single semantic factor.

Where there seems no great likelihood of a code being required as a basic unit for use in longer codes, it is better to use more than one semantic factor, in order to provide additional identification in the code. On the whole, codes of two and three semantic factors are to be preferred. The number of factors used, of course, depends largely on the number of inherent concepts which might be of interest to a specialist in the field for which the code is designed; nevertheless, the preceding considerations should be kept in mind.

The next problem is the choice of the semantic factors themselves. It is assumed that the encoder has become well enough acquainted with the code dictionary to know how the various factors are used to represent concepts and combinations of concepts. It is desirable at this point to check in the dictionary for words having concepts in common with the new word to see what factors were used. It may also be helpful to check for other concepts not closely related, but in the same broad category, in order to get some idea of what factors to choose.

After deciding tentatively what factors to use, it is important to check those parts of the reverse code dictionary where the chosen factors appear, to see whether the words which have already been identified by those factors do indeed represent closely related concepts. One of the most valuable roles of the reverse code dictionary is its function as a guide for maintaining consistency in making new codes. An English word has optimum retrievability only if its code is placed in a compatible "semantic environment."

When the factors are being assigned, the encoder must, to emphasize the matter again, avoid attempting to classify the word or to define it except insofar as this may help the searching procedure. To some extent the concept represented by a word is affected by the context in which the word is used. When the same word appears in different contexts, the significant elements of the concept represented by the word are likely to be different. This naturally affects the code. Thus a code which may be perfectly satisfactory for material dealing with one field, for instance medicine, might be unsatisfactory to another field, for instance education, where the connotation of the word is very different. The encoder should attempt to make the code suitable for any possible context, unless by so doing he waters it down to the point where it has very little meaning and therefore very little value.

There can, of course, be no absolute rules on which factors to use in a code. Any attempt to set up such rules would affect the whole system adversely by depriving it of its flexibility. The most important rule governs how to choose factors: consult the reverse code dictionary and follow precedent, as explained above. A few other points about approach may be made.

One of these is the use of the numerical infix. This can be very effective in a search, and thus should be assigned whenever it provides a useful differentiation. The absence of a numerical infix implies the generic concept represented by the factor. But in some cases a particular sub-concept must be specified. With experience the encoder will find that some factors are in fact more generic than others, that is they have a broader concept-coverage and will more often need to be accompanied by specifying end numbers when appearing in multi-factor codes. For example, the difference between GAPR.1106 (giftedness) and GAPR.1101 (readiness) is such that the end numbers must be included when these concepts are wanted. Where, however, the end number of a single semantic factor word merely provides an unnecessary or misleading distinction, it should not be used as an infix. For example, DACT.1001 is "direction," DYCT.1102 is "trend," DYCT.1104 is "approach" and DACT.1152 is "bias." All of these may be expressed in most multi-factor codes imply by D-CT, because the concept for which D-CT is used will usually incorporate something of all these sub-concepts, and others.

Another point to remember is that ordinarily it is going to be more helpful to describe the function of a concept than to describe its physical characteristics. A question about tests, for example, would probably be concerned with tests which measure a specified factor rather than test of a specified format--although the questioner himself may not realize this.

A third point to remember is that the word will always be accompanied by a role indicator which will give a certain amount of information about the concept to which it is attached, thus relieving the code of some responsibility. Perhaps this is most obvious in those codes which identify a process. Usually, the fact that a given concept involves a process can be established with the infix "U" or will be shown by the role-indicator: the factor P-SS will rarely be needed to identify a term as a process, though it does have other uses.

The encoder will find that some factors, in their generic form--most notably P-SS, G-PR (general property) and R-PR (relative property) -- are useful in codes not so much for the concept which they bring into the code, as for the context they provide by which some other specific subconcepts may be represented. For example the codes for counselling, recommending and suggesting (and their variants) all contain the factor P-SS with N-LL.1106 (analysis, specifically advice); the use of P-SS makes it possible to incorporate the "advice" concept in the codes for these words without giving them identical codes. Thus they are related in the semantic code thesaurus without being recorded as full synonyms. The factor G-PR is commonly added to other factors to encode the variant forms ending in "-ivity," "-ness," and "-ility."

Once the factors have been chosen, the encoder writes them on the listing following the word. They should be in alphabetical order and numerical infixes, if any, should be included. The encoder may then supply the appropriate alphabetic infixes to indicate analytic relationships between the semantic factors and the concept they represent.

It has been found that these infixes may most easily be assigned by considering each letter as standing for certain phrases, as shown in the following charts.

	Meaning		
Letter	Concept		Factor
A	______	is a member of the class	______
E	______	is composed, or made of	______
I	______	is a component of	______
O	______	is made up of several	______
Q	______	makes use of	______
U	______	is used for	______
V	______	acts upon, or causes	______
W	______	is acted upon by, or produced by	______
X	______	is characterized by an absence of	______
Y	______	is importantly connected with	______
Z	______	resembles, but is not	______

If the concept		Factor	Use
______	is a	______	A
______	is made of	______	E
______	is part of	______	I
______	is made up of several	______	O
______	is used for	______	U
______	uses	______	Q
______	brings about	______	V
______	is brought about by, is affected by	______	W
______	is connected with	______	Y
______	is characterized by the absence of	______	X
______	resembles, but is not	______	Z

The encoder may think of the word being encoded as being followed first by the appropriate phrase from this list, then by the semantic factor, repeating the operation as often as necessary for the number of semantic factors used. For example, the Lee-Thorpe OI (Occupational Inventory) has been assigned the following factors: D-CM (document), M-MT-1103 (emotion, specifically interest), M-SR (measurement) and N-DS-1100 (industry, specifically vocation). The Lee-Thorpe OI is a document, affected by interest, used for measuring, connected with vocations. To put this in a form resembling a normal phrasing and word usage -- it is a written record used to measure vocational interest. Therefore the infixes A, W, U and Y, respectively, are assigned, making the code DACM MWMT.1103 MUSR NYDS.1100.

The commonly used infixes are A, U, Q, W, V and Y. As the code dictionary has been developed, the other infixes have come to have rather limited usages. The encoder may be tempted to use the Z freely as an easy way out of problems. Actually, Z should be used very rarely, and then only when it seems probable that a program would search for the particular concept as related to something else in general usage rather than in its true meaning.

When all the new codes have been made for a listing, the encoder assigns end numbers. As the reader may have noticed, the first digit of the end number represents the number of semantic factors in the code. The encoder will find it convenient to assign this first digit while making each new code. For the remaining three digits the encoder may use any number from 100 to 999, preferably the same number for all new codes on one page of a listing,* taking care to avoid duplication of end numbers for identical single semantic factors having different meanings and for common combinations of factors such as the codes for common types of tests and for specific colleges. A record of end numbers for single-factor codes is available for reference, and should be kept up to date.

The encoder may occasionally find codes which need to be changed, and he should make these changes as they are needed. From time to time retroactive code changes can be made, by rewriting the portions of stored magnetic tape on which the faulty codes appear.

Responsibilities of the Encoder

The ultimate goal of the semantic code--the release of information--must always be kept uppermost in the encoder's mind. There is always the temptation to think of the semantic code as an end in itself and to strive for elegance of expression within a code. Elegance may sometimes inhibit rather than assist the release of information, and must never be sought at the expense of usefulness. Probably the pitfall most difficult to avoid, in encoding the terminology of the behavioral and social scientists, is the temptation to editorialize when assigning codes. Many terms used in these fields have strong personal meanings which vary from one individual to another. The coder must sub-

*As the education code dictionary grows and the listings contain fewer uncoded words, it will be possible to use the same end number for a whole listing.

ordinate his own biases, for example, in order to make similar codes for "underachiever" and "overachiever," or for "democracy," "socialism" and "communism." He must always keep in mind the ultimate purpose of the code and of the related technical operations, which is information retrieval for the specialist in the field.

The encoder should remember that the encoding process in one part of a system which also involves telegraphic abstracting and the searching and correlating functions of a general-purpose computer. He must, therefore, design each code in such a way that it will be useful first in the context of a telegraphic abstract and second in the context of a question. This will require some knowledge of the telegraphic abstracting technique and the procedure for analysis and programming of questions. He must know something of the machine procedures used in performing the various operations involved in literature searching. Furthermore, he should keep informed of the topics on which searches are being made.

Obviously, the encoder must have a broad, though not necessarily deep, knowledge not only of the primary field with which his subject material is concerned, but also of related fields. If he does not already have this knowledge, he must develop it by studying the literature of these fields, with a view to grasping the underlying principles and to becoming familiar with the special vocabulary and word-usage. He must learn to use technical glossaries, dictionaries and similar reference works. He must be able to recognize in context the concepts represented by the new words he encounters, because many of them are so recently developed that they are not included in available reference material.

A general familiarity with the fields involved will enable the encoder to anticipate the kinds of information that will be sought. With this understanding he can foresee expanding development in certain areas, and make his codes in such a way that they will be useful in developing further codes, within the framework of the semantic code, should such expansion occur.

Obviously, to do all this, the perfect encoder would be a combination of genius, seer, prophet, linguist, and memory wizard. It is not likely, therefore, that there will ever be a perfect encoder. Nevertheless, the encoder must do his best to create codes which, if not perfect, will be as useful as possible. In this way he can best contribute to the making of a semantic code which will fulfill its purpose as a tool in the WRU system of information retrieval.

References

James W. Perry, Allen Kent, and Madeline M. Berry, Machine Literature Searching. New York, Interscience Publishers, Inc., 1956. Particularly Chapter XI, "Construction of Machine Language."

J. W. Perry and Allen Kent, eds., Tools for Machine Literature Searching. New York, Interscience Publishers, Inc., 1958. Particularly Chapter 9, "The Semantic Code." Chapter 10, "Special Codes," Chapter 5, "Procedures for Preparation of Abstracts for Encoding," and Chapter 15, "Introduction to Analysis of Questions," are also very important to the encoder.

John L. Melton, "The Semantic Code Today." Section V of Test Program for Evaluating Procedures for the Exploration of Literature of Interest to Metallurgists, Report to the National Science Foundation, 1961.

APPENDIX C

PART 2

SEMANTIC FACTORS FOR EDUCATIONAL TERMS: SAMPLES

Appendix C - Part Two

Semantic Factors Used to Encode Education Terminology

Factor	Concept
B-FL	Body Fluid
B-GN	Origin
B-LD	Building
B-MM	Beam (of light & higher-wavelength radiation)
B-NN	Finance, Money
B-PB	Bone
B-PC	Cardiovascular System
B-PG	Body Part
B-PM	Muscle
B-PN	Nervous System
B-PR	Respiratory System
B-PS	Sense Organ
B-RD	Bird
B-SS	Foundation
B-TN	Vegetation, Plant
B-TT	Striking
C-BL	Cable
C-CP	Occupying, Containing
C-CR	Cover
C-LC	Calculation
C-LL	Living Cell
C-LM	Climate
C-LN	Cleaning

Factor	Concept
C-LR	Color
C-LT	Clothing
C-MB	Combustion
C-MF	Concealment
C-MT	Direct Communication, Language
C-NC	Concentration
C-NG	Change
C-NS	Fabrication
C-NT	Connection
C-PR	Chemical
C-RB	Carboniferous Material
C-RM	Ceramics
C-RR	Transportation
C-RS	Crystalline Material
C-RT	Circuit
C-TR	Container
C-TT	Cutting
D-CM	Recorded Information
D-CT	Direction
D-DD	Damage
D-DT	Addition
D-FF	Diffusion
D-FL	Deflection
D-FT	Defect
D-MN	Administration
D-SG	Disease

Factor	Concept
D-SM	Dismantling
D-SP	Display
D-TC	Detection
D-TR	Deterioration, Wearing Down
F-DD	Substances Produced as Food
F-LL	Substances Produced as Fuel
F-LM	Flame
F-RM	Formula (Scientific of Mathematical)
F-RN	Furniture
F-ST	Fastening
G-GD	Guiding
G-GG	Egg, Seed
G-NT	Agent -- Cause or Influence
G-PR	General Property
G-RD	Ground, Earth
G-RM	Agreement, Interpersonal or Intergroup
G-RP	Group
G-RT	Growth
G-SS	Gaseous Material
H-CL	Vehicle for Transportation
H-DR	Water
H-LL	Hole
H-LP	Help
H-ND	Manipulation
L-CN	Location
L-CT	Electricity

Factor	Concept
L-GL	Legal
L-MB	Substances Produced as Lumber
L-MN	Unit
L-PR	Biological Property
L-ST	Livestock
M-CH	Device
M-CL	Dynamics (Physical)
M-CR	Bacteria
M-GN	Magnetism
M-LC	Molecule
M-LT	Military
M-MT	Emotion
M-NR	Mineral
M-PR	Material (Sensible) Property
M-SM	Amusement, Sport
M-SR	Measurement
M-TL	Metal
M-TN	Motion
M-TR	Mixture
M-TT	Matter
N-BT	Inhibition, Handicap
N-CL	Nuclear Energy
N-DS	Industry, Generalized Vocation
N-LL	Analysis, Mental Activity
N-ML	Animal
N-RG	Energy of All Kinds

Factor	Concept
N-TR	Entrance, Reception
P-CT	Projectile
P-LC	Policy, Plan
P-NT	Paint
P-PH	Particle of Physics
P-PL	Human Being
P-PN	Application, Use
P-PP	Paper
P-PR	Physical Property
P-RD	Product, Effect
P-RN	Printing
P-RS	Pressure of All Kinds
P-SH	Push-Pull
P-SS	Process
P-ST	Insect
P-TC	Optics
P-TG	Photography
P-TR	Petroleum
P-TT	Protection
R-BB	Rubber
R-BL	Biological (Familial) Relations
R-CR	Recovery, Repair
R-DC	Material Reduction
R-DT	Radiation (of energy below the wavelength of light)
R-FL	Reflection (light and other energy)
R-GL	Regulation

Factor	Concept
R-HT	Heat
R-LG	Religion
R-LS	Release
R-LT	Light
R-ML	Removal
R-MM	Weapon
R-NG	Arrangement, Rank
R-PR	Relative Property
R-SN	Resin
S-CH	Education
S-CN	Science
S-CR	Residue, By-product
S-CT	Society
S-GN	Symbol
S-GT	Sight
S-HP	Ship
S-HT	Sheet, Layer
S-LL	Commerce (Purchase and Sale)
S-LT	Framework
S-ND	Sound
S-PP	Supply
S-PR	Separation, Purification
S-RR	Aeronautics and Astronautics
S-TG	Storage
S-TM	Stimulus-Response
S-TR	Star

Factor	Concept
T-CH	Etching, Scratching
T-HR	Theory
T-MM	Time
T-MS	Atmosphere, Air
T-RM	Termination, Limit
T-RN	Transmission
T-RT	Medical Treatment
T-TL	Textile

APPENDIX C

PART 3

SEMANTIC CODES FOR EDUCATIONAL TERMS: SAMPLES (LISTED BY CODES)

SEMANTIC CODES FOR EDUCATION TERMS: SAMPLES

SACH.1001	education
SUCH.1005	training
SACH.1006	higher education
SUCH.1101	learning
SUCH.1105	teaching
SYCH.1107	professional
SUCH.1109	teacher training
SUCH.1187	tutoring
PAPL.1001	human being
PAPL.1004	child
PAPL.1101	adult
PAPL.1129	citizen
DAMN.1001	administration
DAMN.1002	government
DAMN.1004	care
DAMN.1100	agency
DYMN.1104	executive
LACN.1001	location
LACN.1008	environment
LACN.1014	position
LACN.1025	region
LYCN.1101	central
LACN.1103	suburb
LACN.1105	home

LACN.1138	Midwest
LACN.1466	space
LUCN.1535	setting
LYCN.1564	outdoor
NALL.1001	analysis
NALL.1002	test
NALL.1023	study
NALL.1102	research
NULL.1104	thinking
NALL.1106	advice
NYLL.1158	deductive
NALL.1532	verification
NULL.1784	understanding
DACM.1001	recorded information
DACM.1003	document
DACM.1011	book
DACM.1021	diagram
DACM.1062	picture
DACM.1107	dissertation
DACM.1163	profile
DACM.1349	IBM card
DACM.1503	newspaper
DWCM.1619	illustrated
DUCM.1889	encoding
CAMT.1001	direct communication
CAMT.1100	language

COMT.1101	vocabulary
CUMT.1102	speaking
CUMT.1109	interviewing
CAMT.1112	French
CAMT.1114	question
CUMT.1117	dramatizing
CAMT.1361	dialect
CAMT.1918	call
MAMT.1001	emotion
MAMT.1014	morale
MAMT.1017	personality
MAMT.1100	motivation
MAMT.1101	anxiety
MAMT.1103	interest
MAMT.1158	desire
MAMT.1222	attitude
MAMT.1370	pride
MAMT.1713	mood
MAMT.1772	happiness

LACN SUCH 2003	school
LACN SUCH 2100	elementary school
LACN SUCH 2103	secondary school
LACN SUCH 2105	academy
LACN SUCH 2360	Collegiate School
LACN SUCH 2532	Phillips Exeter Academy
LACN SUCH NULL 3100	laboratory school
LACN SUCH.1006 2005	college
LACN SUCH.1006 2012	Duquesne University
LACN SUCH.1006 2016	Harvard University
LACN SUCH.1006 2030	University of California
LACN SUCH.1109 2104	School of Education
LACN SUCH.1109 2100	George Peabody College for Teachers
LACN SUCH.1109 2345	Ball State Teachers College
LACN DVCM 2001	library
LYCN DUCM PAPL 3100	librarian
LACN DUMN 2001	office
LACN DWMN 2100	state
LACN DWMN 2101	city
LYCN.1105 DAMN 2134	home economics
LYCN.1105 PAPL 2525	housewife
LYCN DYMN GARP 3568	nation (GARP = group)
LACN DUMN RYLG 3550	diocese (RYLG = religious)
LACN NYBT.1046 NYLL.1104 SUCH 4180	Rome State School (NYBT.1046 = retarded)
LACN NULL 2100	laboratory
LYCN NALL 2133	field study

SUCH DACM 2100	textbook
SUCH DACM PWLC.1003 3549	cutback page book (PWLC. 1003 = programmed)
SUCH DACM PWLC.1003 3568	pulltab device
SVCH DAMN 2100	department of education
SYCH DUMN GARP 3190	UNESCO
SYCH DUMN GARP 3382	National Education Association
SYCH DUMN PAPL 3100	principal
SWCH PAPL 2001	student
SUCH PAPL 2002	teacher
SWCH.1109 PAPL 2103	practice teacher
SWCH.1005 PAPL 2100	trainee
SXCH.1107 PAPL 2100	layman
SUCH PAPL RYLG 3562	missionary
SYCH PALC.1003 2001	curriculum
SYCH PULC.1003 TAHR 3556	Holland programming (TAHR = theory)
NALL CYLC.1102 CUNG.1072 3100	F analysis (CYLC.1102 = statistical; CUNG.1072 = variance)
NULL CALC.1102 RYPR.1317 3784	phi coefficient (RYPR.1317 = correlation)
NULL DACM 2100	criterion
NULL.1102 DAMN 2542	American Institute for Research
NULL.1002 DAMN SYCH 3160	Educational Testing Service
NQLL.1106 GAGD 2100	guidance (GAGD = guide)
NYLL MAMT 2142	realism
NYLL MAMT RVGL 3106	authoritarianism
NYLL MAMT CXNG 3111	conservatism (CXNG = non-change)
NULL.1106 PAPL 2100	counselor

LACN PYPL.1004 2100	day care center
LYCN PAPL SYCH 3150	alumnus
LACN RUGL 2399	prison (RUGL = controlling)
DACM CUMT.1114 2100	questionnaire
DACM CUMT.1117 2100	skit
DOCM CYNS.1100 2100	literature (CYNS.1100 = art)
DACM CYNS.1100 CUMT.1117 3100	drama
DYCM CWNS.1100 PALC.1003 SUCH 4332	great books program
DACM GUGD 2163	guidebook
DOCM GUNT.1100 2757	propaganda (GUNT.1100 = influencing)
DACM GYPR.1105 MUSR 3100	Herman Nelson IT (GYPR.1105 = intelligence)
DACM GYPR.1105 LYCN.1466 MUSR 4731	Space Relations DAT
DACM GYPR.1105 MUSR PVPL.1101 4100	Wechsler Adult IS
DACM MYMT 1017 MUSR 3128	California Test of Personality
DACM MYMT.1017 MUSR 3304	Rorschach inkblot
DACM MYMT.1017 MUSR 3392	Chaplin Q Sort
DACM MYMT.1222 MUSR 3151	AVL Values Study
DQCM MAMT.1222 MUSR 3181	semantic differential
DACM MUSR PYRD.1101 3101	ETS Cooperative Test (PYRD.1101 = achievement)
DACM MUSR PYRD.1101 3138	Metropolitan AT
DUCM PAPL 2166	journalist
DACM RYLG 2100	Bible
DACM SUND.1004 2100	song (SUND.1004 = music)
DACM SUPT.1100 2735	ballot (SUPT.1100 = choosing)

NYLL.1104 PARD 2100	concept (PARD = product)
NULL.1104 PASS 2314	deliberation (PASS = process)
NALL.1106 PWSS 2101	recommendation
CAMT GUNT.1100 2730	rhetoric
CYMT.1100 GAPR 2100	literacy (GAPR = general property)
CVMT.1102 GAPR 2150	articulation
CUMT.1100 LACN SUCH 3100	language lab
CVMT NUTR.1100 2100	reading (NUTR.1100 = receiving)
CVMT MACH NUTR.1100 3100	tachistoscope (MACH = device)
CYMT DACM MUSR NYTR.1100 4101	Chicago Reading Test
CYMT DACM MUSR NYTR.1100 4165	Iowa Silent Reading Test
CUMT SQGN 2100	writing (SQGN = by symbol)
MYMT.1100 BAGN 2313	challenge (BAGN = beginning)
MYMT DACT 2752	extroversion (DACT = direction)
MAMT DVCT NYLL 3369	optimism
MVMT DYSG 2100	neurotic (DYSG = diseased)
MWMT GAPR NWLL 3199	humor
MYMT NARG 2701	exuberance (NARG = energy)
MAMT PYLC 2127	aspiration (PYLC = connected with a plan)
MAMT PUTT 2590	defensiveness (PUTT = protecting)
MAMT RVPR 2591	friendliness (RAPR = relative property)
MWMT RAPR 2591	friendship
MWMT RAPR 2100	popularity
MWMT SACN 2100	psychiatry (SACN = science)
MYMT SAGN 2181	self concept
MYMT SAGN 2355	stereotype

APPENDIX C

PART 4

SEMANTIC CODES FOR EDUCATIONAL TERMS: SAMPLES (LISTED BY ENGLISH WORDS)

SEMANTIC CODE FOR EDUCATION TERMS; SAMPLES, ENGLISH TO CODE

academy	LACN SUCH 2105
administration	DAMN.1001
adult	PAPL.1101
advice	NALL.1106
agency	DAMN.1101
alumnus	LYCN PAPL SYCH 3150
American Institute for Research	DAMN NULL.1102 2598
analysis	NALL.1001
anxiety	MAMT.1101
aspiration	MAMT PYLC 2127
attitude	MAMT.1222
authoritarianism	MYMT NYLL RVGL 3106
AVL Values Study	DACM MYMT.1222 MUSR 3151
ballot	DACM SUPT.1100 2735
bible	DACM RYLG 2100
book	DACM.1011
California TP	DACM MYMT.1017 MUSR 3128
call	CAMT.1918
care	DAMN.1004
central	LACN.1101
challenge	BAGN MYMT.1100 2313
Chaplin Q Sort	DACM MYMT.1017 MUSR 3392
Chicago Reading Test	CYMT DACM MUST NYTR.1100 4101
child	PAPL.1004
citizen	PAPL.1129

city	DWMN LACN 2101
college	LACN SUCH.1006 2005
collegiate school	LACN SUCH 2360
concept	NYLL.1104 PARD 2100
conservatism	CXNG MAMT NYLL 3111
counselor	NULL.1106 PAPL 2100
criterion	DACM NULL RUGL 3100
curriculum	PALC.1003 SYCH 2001
cutback page book	DACM PWLC.1003 SUCH 2549
day care center	LACN PYPL.1004 2100
deductive	NYLL.1158
defensiveness	MAMT PUTT 2590
deliberation	NULL.1104 PASS 2314
Department of Education	DUMN LAMN SVCH 3100
desire	MAMT.1158
diagram	DACM.1021
dialect	CAMT.1361
diocese	DUMN LACN RYLG 3550
dissertation	DACM.1107
document	DACM.1003
drama	CUMT.1117 CYNS.1100 DACM 3100
dramatizing	CUMT.1117
Educational Testing Service	DAMN NULL.1002 SYCH 3160
education	SACH.1001
elementary school	LACN SUCH 2100
emotion	MAMT.1001

encoding	DUCM.1889
environment	LACN.1008
ETS Cooperative Test	DACM MUSR PYRD.1101 3101
executive	DYMN.1104
extroversion	DACT MYMT 2752
exuberance	MYMT NARG 2701
F analysis	CYLC.1102 CUNG.1072 NALL 3100
field study	LYCN NALL 2133
French	CAMT.1112
friendliness	MYMT.1109 RAPR 2591
friendship	MAMT.1109
government	DAMN.1002
great books program	CUNS.1100 DYCM PALC.1003 SUCH 4332
guidebook	DACM GUGD 2163
happiness	MAMT.1772
Henman Nelson IT	DACM GYPR.1105 MUSR 3100
higher education	SACH.1006
Holland programming	PULC.1003 SYCH TAHR 3556
home	LACN.1105
home economics	DAMN LYCN.1105 2134
housewife	LYCN.1105 PAPL 2525
human being	PAPL.1001
humor	GAPR MWMT NWLL 3199
IBM card	DACM.1349
illustrated	DWCM.1619
information	DACM.1001

interest	MAMT.1103
interviewing	CUMT.1109
Iowa Silent Reading Test	CYMT DACM MUSR NYTR.1100 4165
journalist	DUCM PAPL 2166
laboratory	LACN NULL 2100
laboratory school	LACN NULL SUCH 3100
language	CAMT.1100
language lab	CVMT.1100 LICN SUCH SQND 4100
layman	PAPL SXCH.1107 2100
learning	SUCH.1101
librarian	DVCM LYCN PAPL 3100
library	DWCM LACN 2736
literacy	CYMT.1100 GAPR 2100
literature	CYNS.1100 DOCM 2100
location	LACN.1001
Metropolitan AT	DACM MUSR PYRD.1101 3138
midwest	LACN.1138
missionary	PAPL RYLG SUCH 3562
mood	MAMT.1713
morale	MAMT.1014
motivation	MAMT.1100
nation	DYMN GARP LYCN 3568
National Education Association	DUMN GARP SYCH 3382
neurotic	DYSG MVMT 2100
newspaper	DACM.1503
optimism	DVCT MAMT NYLL 3369

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outdoor	LYCN.1564
personality	MAMT.1017
phi coefficient	CALC.1102 NULL RYPR.1317 3784
popularity	MWMT RAPR 2100
position	LACN.1014
practice teacher	PAPL SWCH.1109 2103
pride	MAMT.1370
principal	DUMN PAPL SYCH 3100
prison	LACN RUGL 2399
professional	SYCH.1107
profile	DACM.1163
psychiatry	MWMT SACN 2100
pulltab device	DACM PWLC.1003 SUCH 3568
question	CAMT.1114
questionaire	CUMT.1114 DACM 2100
reading	CVMT NUTR.1100 2100
realism	MAMT NYLL 2142
recommendation	NALL.1106 PWSS 2101
region	LACN.1025
research	NULL.1102
rhetoric	CAMT GUNT.1100 2730
Rorschach inkblot	DACM MYMT.1017 MUSR 3304
school	LACN SUCH 2003
School of Education	LACN SUCH 2104
secondary school	LACN SUCH 2103
self concept	MYMT SAGN 2181

semantic differential	DQCM MAMT.1222 MWSR 3181
setting	LUCN.1535
skit	CUMT.1117 DACM 2100
song	DACM SUND.1004 2100
space	LACN.1466
Space Relations DAT	DACM GWPR.1105 LYCN.1466 MUSR 4731
speaking	CUMT.1102
state	DWMN LACN 2100
stereotype	MYMT SAGN 2355
student	PAPL SQCH 2001
study	NALL.1023
suburb	LACN.1103
tachistoscope	CVMT MACH NUTR.1100 3100
teacher	PAPL SUCH 2002
teacher training	SUCH.1109
teaching	SUCH.1105
test	NALL.1002
textbook	DACM SUCH 2100
thinking	NYLL.1104
trainee	PAPL SWCH.1005 2100
training	SUCH.1005
tutoring	SUCH.1187
understanding	NULL.1784
verification	NALL.1532
vocabulary	COMT.1101
Wechsler IS	DACM GYPR.1105 MUSR 3191
writing	CUMT SQGN 2100

Ball State Teachers College	LACN SUCH.1109 2345
Duquesne University	LACN SUCH.1006 2012
George Peabody College for Teachers	LACN SUCH.1109 2100
Harvard University	LACN SUCH.1006 2016
Rome State School	LACN NYBT.1046 NYLL.1104 SUCH 4180
University of California	LACN SUCH.1006 2030
UNESCO	DUMN GARP SYCH 3190

APPENDIX D

PILOT QUESTIONS

QUESTIONS RECEIVED July 1961 to April 1962

Q no.	*	Letter no.
* 1.	The gifted underachiever: problems, causes, motivation and post-high school experience	L1
* 2.	High school biology films	L2
* 3.	Group counseling	L3a
* 4.	Team teaching (also L148, 150, 172, 22a, 241)	L3b
* 5.	Acceleration and enrichment	L3d
* 6.	Use of local citizens to provide supplementary teaching for gifted children (use L64, part)	L5a
* 7.	Foreign language teaching in elementary grades (also L171, 177, 186, 237, 251)	L5b
* 8.	Guidance problems peculiar to suburban communities	L5c
* 9.	Citizen opposition to school budgets and construction plans--reasons	L5d
*10.	Advanced programs for developing excellence in sciences, mathematics and language	L7b
*11.	Teaching machines, programmed learning and auto-instructional devices (also L10, 12a, 14a, 35a, 39, 47b, 75a, 85b, 86, 89, 103b, 172, 126, 127, 189, 215d, 225, 101, 238, 247) (see L146)	L6a
*12.	Motivating undergraduate college students toward independent study, use of library and academic interest	L7a
*13.	Ability and inability to concentrate while studying or doing clerical work	L7b
*14.	Basic skills and curriculum in elementary schools	L8a
*15.	Change in educational level, U.S., 1931-1961	L8b
*16.	Effect of environment on intelligence	L8c
*17.	Elementary school extra-curricular activities	L8d

* designates those questions for which searches have been made to date

Q no.		Letter no.
*18.	History of guidance in elementary education	L8e
19.	New method of math teaching worked out at Yale	L8f
*20.	Interscholastic athletics in junior high schools	L8g
21.	Bibliography of audiovisual magazines for teaching modern languages	L8h
*22.	List of dissertations in educational administration	L8i
*23.	Curriculum planning	L8k
*24.	The delinquent child in the public school system (also 215a)	L8j
25.	Over-achievers (also 198e)	L8l
*26.	Research on the teaching of social studies (also L240)	L8m,x
27.	Regulations concerned with ventilation in Pennsylvania schools	L8n
*28.	Educational testing (reliability, etc.) (also L107a, 186, 244d)	L8y,z
*29.	Reading ability (also L47a, 194d)	L8p
*30.	Role-playing as a method of teaching	L8w
31.	Social and economic status of professors in the USSR	L8r
32.	Statistics about education in Vietnam	L8s
*33.	Teachers' salaries compared with other occupations	L8t
*34.	Teaching of language arts (also L52a)	L8u
35.	Trimester vs. semester or quarter plan (see L250)	L8v
36.	Visual perception in relation to beginning reading: vision and reading success	L9c-d
*37.	Use of teaching machines to teach college mathematics	L12c
*38.	Description of working models of teaching machines (also L89)	L12b
39.	At what age level is it best to begin the teaching of science?	L13a

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*40.	New methods of science teaching; new techniques in chemical education	L13b-c
*41.	Results of programmed learning as compared with other teaching methods (also L209b, 180b, L62)	L14b
42.	Course curricula and teaching methods in the fields of digital computer programming and computational mathematics (also L86b, 98c, 251 c, education in automatic data processing)	L14c
*43.	Effect of student motivation and instructor personality (chiefly motivation) on college learning	L15
*44.	All aspects of the counseling process (also L216)	L16
*45.	High school and college students' perceptions of vocations and their influence upon vocational choice	L17
*46.	Concept formation in the mentally retarded (also 34d)	L18
47.	Techniques for teaching language (not speech) to deaf children who have lost their hearing prior to age three	L19a
*48.	Use of audiovisual aids in teaching deaf children	L19b
49.	Use of Word Association Tests with deaf persons (children and adults) for any kind of diagnostic or investigative purpose	L19c
50.	What instruments have been either proposed or used to measure a student's degree of self-reliance in pursuing intellectual goals?	L22
*51.	Diagnostic and remedial procedures in reading (also L55b)	L9a
52.	Teaching of probability and/or statistics in primary and secondary schools	L24a
*53.	Application of teaching machines for adult vocational education (also L80)	L24b
*54.	Enrollment forecasting by year and field, year-by-year attrition rate, dropouts, transfers-in and interfield transfers (change of field) in engineering colleges	L25
55.	Reading speed-up training and quality of output thereafter (use L55b, part)	L26a

Q no.		Letter no.
56.	Statistical studies on cancer internships, with follow-up	L26b
57.	Statistics on pharmacology postdoctoral fellows	L26c
58.	Foreign students who return to homeland (statistics)	L26d
59.	Relation between certification programs in professions and appreciation by the public of that profession	L26e
60.	Value of drugs in: physical rehabilitation and retaining of accident victims; training handicapped children; education of the subnormal	L26f
61.	The physiological process associated with reading printed or written matter	L27
62.	Adult education: *general (also L29a, 80)	L28a,x
	*college-level only (also L242)	L28b
	*administration of college-level; any level	L28c,e
	*curriculum development only, college-level	L28d
63.	Adult learning: general (also L29b, 242)	L28g
	comparison with college adolescent learning	L28h
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64.	Recorded reading materials for blind people (not Braille)	L31
65.	Analytic geometry in the high school	L11a
66.	Mathematics without numbers	L11b
67.	Mathematics learning theory	L11c
*68.	Introductory college mathematics	L11d
69.	Effects of chemical agents (drugs) on learning processes in humans	L32
*70.	Latest development in using computers as teaching machines	L40
*71.	Role of the public school teacher: role terms and theory; methods of role analysis; role conflict	L38
*72.	Materials pertaining to the development of efficient thinking processes	L39b

Q no.		Letter no.
73.	Item analysis of wrong answers to the questions on a professional examination in clinical psychology, psychiatry, psychiatric social work, psychiatric nursing (to aid in objective test development for professional personnel selection)	L48
74.	Research on elementary school science: a)* problem-solving b)* presenting or doing experiments c) techniques of evaluating attitudes (use L82a)	L45a-c
75.	Teaching aids for chemistry and chemical industry (also L82i)	L33
76.	Teaching of mathematical logic to elementary school children	L35b
77.	Concept formation *(a) in children, *(b) in talented pupils, *(c) in young children. (d) Concept formation in young mentally retarded children as an indicator of educability. (also L34c, 35c, 44c, 74, 79, 84)	L42a-d
78.	Autotelic learning situations	L35d
*79.	Learning games	L35e
80.	Personality traits as they influence occupational choice: *(a) in general; (b) in military service; (c) for nonflying officers who choose to remain in the air force	L36a-c
*81.	How to teach children to study independently (in memory, reasoning, organization of work) in preparation for the creative type of learning required in secondary school. (also L37)	L34b
*82.	Successful methods of grouping (also L112a, 126, 141, 186, 194c, 219, 147)	L34a
*83.	Driver education	L54
84.	Grading techniques which do not penalize lesser achievers in academically talented groups	L34f
*85.	Closed circuit TV projects and methods which have proved successful in schools. (also L256)	L34g
86.	A comparative evaluation of the major proposal for the teaching of modern mathematics	L34h

Q. no.		
87.	Successful devices used to win community support of school referenda	L34i
*88.	Experimental studies on the influence of teacher's personality on classroom behavior	L43
*89.	The slow learner (70-90 IQ) (also L137, 194b, 133b, 244c)	L41
*90.	Curriculum developments involving interdisciplinary organization (core curriculum, integration) at all levels	L46a
91.	Curriculum procedures and practices which help bridge the gap between general and specialized education	L46b
*92.	Reading potential or capacity (L8p + readiness)	L47a
*93.	Teacher education (also L49b)	L53
*94.	Mentally retarded: learning processes and teaching methods (also L99a, 146, 177)	L55a
*95.	Remedial reading for children under 14 (also L3b)	L55b
96.	Examinations for predicting and evaluating competency of medical residents and interns	L50
*97.	Audiovisual usage in schools (current) (also L127, 170)	L52c
*98.	Educational TV (also L172, 126, 236, 239, 243a, 255)	L52d
*99.	Teacher recruitment	L49c
100.	School personnel administration	L49a
*101.	Curriculum for undergraduate engineers: general and electronics	L51a,b
102.	Reeducation for practicing engineers: (a) general, (b) for electrical engineers, about transistors, (c) to change field	L51c-e
*103.	Learning problems for poor students in seventh and eighth grade arithmetic	L4a
*104.	Success of able students taking algebra in eighth grade--in algebra and later math courses	L4b
*105.	Effects on able students' college careers of advanced placement as entering freshmen	L4c

Q no.		Letter no.
106.	Mechanical and electronic scheduling systems	L6e
*107.	Class size and teaching effectiveness (also L107c)	L6d
108.	Development of manipulative skills--	
	*a) general (also L169)	L20a,y
	b) related to industry (also L243b)	L20b
	c) in students under 18 enrolled in day trade vocational machine shops	L20c
109.	Sequential analysis--	
	a) general	L20d
	b) in application to performance testing	L20e
	c) "tab test" only	L20f
*110.	Teaching mathematics to bright students	L11e
*111.	Interactions of persons or groups	L21a
112.	Effects of individual cognitive structure on communication or interaction between individuals	L21b
113.	Effectiveness of techniques in adult education on retention, etc.	L29c
*114.	Relationship of scholastic achievement to success on the job	L29d
*115.	Cooperation of industry with educational institutions	L29e
116.	Industrial training for adults established in the past 10 years, including effectiveness	L29f
*117.	Listening comprehension	L30
118.	Merit rating (salary) plans that have proved effective (also L201, incentives for superior teaching)	L34e
*119.	Concept formation (also L61b)	L44
*120.	Design, preparation and use of illustrations (all kinds) in industrial education	L56a
121.	Methods of measuring progress and grading students in non-testable courses (seminar type)	L56b
122.	Methods of teaching basic industrial statistics to personnel with no more than 8th-grade education	L56c

Q no.		Letter no.
123.	a) Education programs for emotionally and socially disturbed children	L57a
	*b) Emotionally and socially disturbed children in residential schools	L57b
	*c) Emotionally and socially disturbed children in special classes in public schools	L57c
124.	Experimental education (techniques and equipment)	L58a
*125.	Educational programs in boarding schools and other controlled environments	L58b
126.	Research on electro-chemical phenomena in the brain related to learning and cognitive processes	L58c
127.	Research on information theory or cybernetics	L58d
128.	Sino-Soviet research in psychology and educational psychology	L58e
*129.	Research on inculcation and reorientation of values (also L129b)	L58f
130.	Role of education in creating the "New Soviet Union" in the USSR	L58g
131.	Interperson perception (awareness and/or accuracy)	L59a
132.	Mental illness prevention in average classroom situation	L253
*133.	Motivation and perseveration as related to learning	L59c
*134.	Learning of auditory discrimination in preschool brain-injured children	L60
*135.	Speech and language development and performance	L61
136.	Administration of legal education	L62a
*137.	Financing of graduate school education	L62b
*138.	Leadership: theory, development, types, and relationship of leadership to creative thinking	L63a
*139.	Sociometric tests (also L59b, 108b)	L63b
*140.	Use of community and other outside resources (persons, materials, field trips) for enrichment and supplementation of instruction (see 5b)	L64

Q no.		Letter no.
*141.	Reading at elementary school level, with emphasis on beginning reading	L65
142.	Prompting (cues) in:	
	*(a) paired associate learning	L66a
	(b) sequential learning	L66b
	*(c) problem solving	L66c
*143.	Anxiety and learning	L66d
144.	Current developments in colleges and universities	L67
*145.	Effects of music in training films	L68a
*146.	Patterns of speech (pitch and value) in educational lectures	L68b
147.	New (since 1955) vocational interest tests	L68c
*148.	Uses of the critical incident technique	L179a
*149.	Research on foreign language teaching (also L68d)	L69
*150.	Role of speed in achievement test scores	L70a
*151.	Methods for checking reliability of achievement tests designed to measure differences in learning as affected by different teaching methods	L70b
*152.	Branching experiments in programmed instruction	L70c
*153.	Changes in intelligence as a function of experience	L71a
*154.	Education of young mentally retarded children	L71b
*155.	Personality evaluation of young mentally retarded children	L71c
156.	Academic affairs or faculty administration in a university	L72a
157.	Procedural operations in an office of a university dean of faculties	L72b
*158.	Specific information on university faculty appointment, recruitment, orientation, promotion, tenure, salary or handbooks	L72c

Q no.		Letter no.
*159.	University faculty relationships with administration, students, or community	L72d
160.	Mechanized (programmed) teaching in medical fields	L73a
161.	Application of television to instrumental observation in medical education	L73b
162.	Constructed answer (Skinner) programming for industrial arts education (also L98b)	L75a
163.	Programming for electricity-electronics information in industrial arts education	L75b
164.	Effects of mass media on the affective aspects of behavior (relevant to teaching).	L253
165.	Comparisons of pupil-directed with teacher-led direct instruction	
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	(c) information on pupil-directed learning (independent study or discovery)	L75d
*166.	Correspondence education	L76
*167.	Theories of teaching: analysis and categorizing of teaching process variables	L77
168.	a. Student interests	L78a
	*b. Relation of student interests to achievement (also L184)	L78b
*169.	Physically, mentally or emotionally handicapped children	L79
170.	a. Everything on training of superior adults	L80a
	b. Methods of in-service training of superior adults	L80b
171.	a. Man-machine systems in psychiatry (general)	L81a
	*b. Use of teaching machines in treating mental illness (more specific)	L81b
	c. Use of teaching machines in improvement of personality adjustment (most specific)	L81c
*172.	Science education in Grades 1-6. (also L258, 123)	L82a
173.	Curricular changes in college chemistry teaching	L82b
174.	Programs supported by private organizations for college teaching of physical sciences	L82c

Q no.		Letter no.
*175.	Programs of independent study in science	L82d
176.	Pretesting to determine future success of college chemistry students	L82e
*177.	Programs for high-ability high school students in science	L82f
178.	Use of hand-sorted punched cards in training of college students in chemistry	L82g
*179.	Use of ETV in the teaching of chemistry to high school and college students	L82h
180.	Organization and changes of college year calendar	L82j
181.	Changes proposed for training of elementary and high school science teachers (grades 1-12)	L82k
182.	Programs to educate the non-science major (college) in natural sciences and mathematics	L82l
183.	Interdisciplinary programs involving chemistry, college level	L82m
184.	Influence of new science buildings on patterns of science education, and vice versa	L82n
185.	Summer research programs for college undergraduates	L82o
186.	Steps being taken to meet the problem of high attrition at private liberal arts colleges	L82p
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188.	Sabbatical and other leave programs for college and high school teachers	L82s
189.	Impact of science affairs on the teaching of science	L82t
*190.	Visiting scientist programs for high schools and colleges	L82u
191.	Foreign exchange programs for undergraduates in chemistry	L82v
192.	Associations for college and high school chemistry teachers	L82w

Q no.		Letter no.
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194.	Pedagogy in higher education	L83
195.	Self-concept or self-acceptance:	
	*a. development with age	L84a
	*b. relation to achievement or behavior (also L97a)	L84b
	*c. modifications through instruction or therapy	L84c
196.	Teaching the use of library and literature searching techniques to science and engineering students, college	L85a
*197.	Teaching of mathematics (general) (check with answers to Q 19, 37, 42, 52, 65-68, 76, 110, 104)	L86c
198.	Factors of social interaction within a school, between and among administrators and teachers (also L213a)	L87a
199.	Objective criteria for evaluating the teaching effectiveness of a school	L87b
200.	Studies of teacher attitudes using latent structure analysis	L87c
*201.	Use of closed circuit TV for inservice training of teachers and administrators	L87d
*202.	Training of administrators (also L139, 105)	L87e
*203.	Education of migratory children (also L203)	L88a
204.	Education problems of minority culture people	L88b
*205.	Films, slides, and filmstrips for Industrial Engineering education	L90
*206.	Sensory (visual & auditory) and motor differences between brain-injured or retarded children and normal children	L91a
*207.	Teaching methods for brain-injured or mentally retarded children (also L99g, 216b, 245)	L91b
208.	Construction and use of biographical inventories for selection of college and university students	L92

Q no.			Letter no.
209.	a.	Sex differences in aptitudes, abilities, learning capacity, intelligence, and performance variability	L93a
	b.	Sex differences in personality traits, school achievement, problem solving, thinking, and attitudes	L93b
	*c.	Everything on sex differences in the field of education	L93c
210.	*a.	Everything on guidance in the elementary school	L94a
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	c.	Influence of elementary school guidance programs on teachers' attitudes	L94c
211.	a.	Major theories of delinquency causation (use L215a, part)	L94d
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212.		Similarities of fathers' and sons' occupational interests in the formative years	L95a
213.		Use of the Kuder Preference Record in high school guidance	L95b
214.		Effect of form of communication on learning: written, verbal or mathematical, pictorial, oral, demonstrational, etc.	L96a
215.		Measurement of creativity among students	L96b
216.		Relationships among measures of manifest anxiety, achievement and school behavior (see L66d)	L96c
217.		Relative roles played by parents and teachers in student's self-concept	L97b
218.		Influence of parents on their children's school performance	L97c
219.		Variables which most significantly influence internal consistency type reliability estimates	L97d

Q no.		Letter no.
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221.	Training of computer programmers (also L251c, education in automatic data processing)	L98c
222.	Motivation of secondary school and college students	L98d
*223.	Everything on academic underachievement (also L168, 254) (see L3c)	L98f
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*225.	Curriculum trends of special education for retarded	L99c
*226.	Team teaching with mentally retarded	L99d
*227.	Programs for the severely retarded	L99e
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*229.	Vocational education of mentally retarded	L99i
230.	Sex education for adolescent mentally retarded	L99j
231.	Designs and theories of psychometrics	L100
*232.	Programmed instruction at the college level (L6a, part)	L101
233.	Education in microbiology	L102a
234.	Education in classification theory, and how classification theory helps education	L102b
235.	Teaching of organic chemistry	L103a
*236.	Theory of programming for machine teaching (also L209a, 252c)	L103c
237.	Programmed learning in the sciences (also L238)	L103d
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Q no.		Letter no.
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240.	Evaluations of teaching machine programs for slow learners	L104c
241.	Role of audio-visual aids in verbal learning -- theoretical and experimental treatments	L106
*242.	Norming studies on achievement and scholastic aptitude tests in public schools (use L8y or z, part)	L107a
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250.	Studies on learning with self-instruction programs in which branching, linear sequence, or type of branching is a variable	L111
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253.	Federal aid to private colleges of less than 1500 enrollment (also L141)	L112c
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255.	Association between the Wechsler Intelligence Scale subtests and reading disabilities	L113b

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*256.	Student personnel accounting -- school records, etc. (also L244b)	L114
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258.	Reliability of the Brace test of motor ability in children under nineteen	L115b
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265.	Scheduling for an extended school day (including studies to determine optimum length of school day) (also L137)	L118
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283.	"Identification" in student-teacher relationships	L135
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289.	Effect of classroom atmosphere on pupils' academic achievement or social development, as found by research	L144a
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361.	Effect of TV on response of low aptitude students	L211
362.	Use of information theory, communication theory, cybernetics or human engineering in educational research	L212a
363.	Parameters of pictorial, visual and graphic stimulus materials in educational measurement	L212b
364.	Criteria for the evaluation of theories or models of learning	L212c
365.	Identification of creative talent in high school students	L213b
366.	Identification of underachievers in high school	L213c

Q no.		Letter no.
367.	Relation of self-concept to motivation in high school students	L213d
368.	Relationship between interest and ability in reading	L214a
369.	Methodology for case studies in education	L214b
370.	Juvenile delinquents: work programs, recreation programs, school methods, prognostic indices, psychological testing and use of operant conditioning techniques (also L8j)	L215a
371.	Operant conditioning in relation to:	
	a. teaching the mentally retarded	L215b
	b. understanding and dealing with emotional problems	L215c
372.	Detection of emotional problems in children	L215e
373.	Inservice training of elementary school teachers in "modern mathematics"	L217
374.	Promotion policies in elementary and secondary schools (see L125)	L218a
375.	Accommodation of slow learner (social promotion) in secondary schools	L218b
376.	Values held by intermediate grade children	L221
377.	Reading process in relation to visual and auditory perception and to conceptual ability	L223
378.	Elementary school administration	L226c
379.	Identifying those slow readers who can be raised to grade level reading	L227a
380.	Effects of reading success on personality	L227b
381.	Intrinsic and extrinsic motivation	L229
382.	Teacher recruitment and selection	L230a
383.	Teacher assignment, load and transfer	L230b
384.	Status and attractions of public school teaching as a profession	L230c

Q no.		Letter no.
385.	Property tax and financial support of public schools	L231
386.	Studies on methodology (research design)	L232a
387.	Impression formation	L232b
388.	Cognitive or perceptual style	L232c
389.	School financial planning	L233
390.	Cost-per-student studies of educational facilities and services	L234
391.	Television instruction in elementary and secondary school sciences, as it effects achievement and attitude toward the subject taught	L235
*392.	The exceptional child (L155a +)	L244a
*393.	The internship in educational administration	L244c
*394.	Elementary school teaching practices	L244f
*395.	Use of analysis of covariance in classroom research	L248a
*396.	Mathematical curricula at the secondary school level	L248b
*397.	High school dropout as related to juvenile delinquency	L249
398.	Student acceptance of full use of calendar year for school (see L8v)	L250
399.	Learning of motor skills from films: effect of a. film production technique variables b. learner participation c. knowledge of results	L252b
400.	Studies in the use of teaching machines for the mentally retarded which consider (a) effectiveness, (b) types of program or (c) types of reward	L257

APPENDIX E

COMPARATIVE SYSTEMS STUDY

PART 1 - TENTATIVE CLASSIFICATION SCHEDULE

PART 2 - SAMPLE TELEGRAPHIC ABSTRACTS AND CLASSIFIED CONVENTIONAL ABSTRACTS

APPENDIX E

PART 1

TENTATIVE CLASSIFICATION SCHEDULE

TENTATIVE CLASSIFICATION SCHEDULE FOR RESEARCH IN EDUCATION

FACETS: POPULATION
MEDIA
TEACHING
ADMINISTRATION
RESEARCH DESIGN

POPULATION (P)

Family Characteristics (PF) (as factor or variable)

Classification and Code		Remarks
Nationality	PFNA	
Race	PFRA	
Religion	PFRE	
Educational level	PFED	
Income	PFIN	......(including socioeconomic level)
Migrant	PFMG	
Marital status	PFMA	

Age Characteristics (PA)

Classification and Code		Remarks
Preschool	PACN	
Children, young	PACY	
Preadolescent	PACP	
Adolescents	PACA	
Young adults	PAYA	
Mature adults	PAMA	
The Aged	PAAG	

Instructional Locale (PL)

Classification and Code		Remarks
Home (e.g. correspondence)	PLHO	
Residential school	PLRE	
Camp	PLCA	
Nursery school	PLNS	
Kindergarten & Primary	PLSP	
Intermediate elementary	PLSI	
Junior high	PLSJ	
Senior high	PLSH	
Church-operated school	PLCO	
Private school (nonsectarian)	PLPV	
Summer school	PLSS	
Special class	PLSC	......(in regular school, pre-college)
Undergraduate college	PLUG	
Graduate school	PLGR	
Armed services school	PLMT	
Vocational school	PLVO	

Classification and Code		Remarks
Professional school	PLPR	
School or Department of Education	PLSE	
On-the-job training	PLOJ	
Physical Characteristics (PP)		
Male	PPSM	
Female	PPSF	
Perception, visual & auditory	PPPE	
Stimulus-Response	PPRS	
Sensory handicap	PPHS	
Motor handicap	PPHM	
Intellectual and Ability Characteristics (PI)		
Low intelligence	PILO	
High intelligence	PIHI	
Mentally retarded	PIMR	
Study skills	PISX	
Motor skills	PIMO	......(including sensorimotor)
Readiness	PIRE	
Number skills	PINS	
Language skills	PILS	
Other talents	PITA	......(specific or general)
Creativity	PICR	
Cognitive skills	PICS	......(concept formation, problem solving, critical thinking)
Emotional Characteristics (PE)		
Achievement, under & over	PEAC	
Interest	PEIN	......(including motivation)
Attitudes & Opinions	PEAO	......(including values)
Maladjustment	PEMA	
Behavior problems	PEBP	
Delinquency	PEDE	
Interpersonal relations	PEIR	
Self-concept	PESC	......(including role-concept)
Non-Student Population (PN)		
Teacher, college or university	PNTC	
Teacher, precollege	PNTS	
Administrator	PNAD	
Parent	PNPA	
Citizen	PNCI	
School board	PNSB	
Librarian	PNLI	......(including AV coordinator)
Critic-or Master-Teacher	PNMT	

Classification and Code		Remarks
	MEDIA (M)	
Television (MT)		
Closed circuit	MTCC	......(educational)
Open circuit	MTOC	......(educational)
Experimental or amateur	MTAX	......(made in school)
As mass media	MTMM	
Videotape recordings	MTVT	
Motion Pictures (MM)		
Silent	MMSI	
Sound	MMSO	
Black & White	MMBW	
Color	MMCO	
Amateur or experimental	MMAX	
Radio (MR)		
Limited network	MREL	......(educational)
Broadcast	MREB	......(educational)
Shortwave	MRSW	
Amateur or experimental	MRAX	
As mass media	MRMM	......(commercial network)
Sound Recordings (MS)		
Disc recordings (phono)	MSDR	
Wire & tape recordings	MSTR	
Amateur or experimental	MSAX	
Language laboratories	MSLL	
Other electronic devices	MSED	
Projected Motionless Visual Images (MP)		
Filmstrips	MPFS	
Slides	MPSL	
Material for overhead & opaque projectors	MPOP	
Micro material	MPMI	
Amateur or experimental	MPAX	
Non-Projected Visual Images (MV)		
Mass media	MVMM	.....(independent reading)
Printed material	MVPN	
Wall displays	MVDS	
Illustrations	MVIL	.....(in books & separate)
Programmed material	MVPM	.....(for use without machine)

Classification and Code		Remarks

Direct Aural, Visual or Tactile Experience (MD)

Science laboratory equipment	MDSL	
Models, mockups, etc.	MDMO	
Realia	MDRE	
Field trips	MDFT	
Other manipulative devices	MDMD	
"Live" presentation	MDLP	(lecture, demonstration, etc.)

Teaching Machines (MA)

Automated self-testing devices	MATE	
Automated self-instruction devices	MASI	
Mechanical reading devices	MARE	(pacers, tachistoscopes)
Programming techniques	MAPG	(for teaching machines)
Stimulators	MASS	(e.g. military training devices)

TEACHING (T)

Subjects of Education (TS)

Agricultural	TSAG	
Business & Commercial	TSBC	
Industrial & Applied Arts	TSIA	
Home economics, Family & Consumer education	TSHE	
Physical education	TSPE	
Communication skills, general	TSCM	
Reading, specifically	TSRD	
Foreign languages	TSFL	
Literature	TSLI	
Fine Arts	TSEA	(visual & drama)
Music	TSMU	
Arithmetic & Mathematics	TSAM	
Sciences, physical	TSSP	
Sciences, biological	TSSB	
Social studies	TSSS	
Religious education	TSRE	
Applied psychology	TSAP	("life adjustment")
Military	TSMI	
Engineering	TSEN	
Medical, Nursing, Dental	TSMH	
Other professional	TSPR	(Architecture, Law, Library, etc.)

Subjects of Teacher Education (TE)

Educational administration	TEAD	
Counselling, guidance	TECG	
Nursery school	TENS	

Classification and Code		Remarks
Kindergarten & elementary	TEEL	
Secondary, academic	TESE	
Secondary, vocational	TESV	
Special subjects	TESS	(e.g. arts, physical education)
Audiovisual education	TEAV	(use of AV materials)
Remedial & corrective	TERC	
Education of retarded	TERE	
Education of handicapped	TEPH	

Teaching Conditions (TC)

Individual tutoring	TCIT	
Ability grouping	TCAG	
Enrichment	TCEN	
Independent study	TCIS	
Non-graded classes	TCNG	
Remedial & corrective	TCRC	
Team teaching	TCTT	
Acceleration	TCAC	
Field work	TCFW	(including practice teaching, work-study programs)

Learning Processes and Factors (TL)

Problem-solving	TLPS	
Reinforcement	TLRE	(including feedback, audience participation)
Step size	TLSS	
Sequence	TLSE	
Drilling, practice	TLDP	
Memorizing	TLME	(including paired-associate learning)
Environment, physical	TLEN	

Test Variables (TT)

Multiple choice	TTMC	
Constructed answer	TTCA	
Projective tests	TTPR	
Essay tests	TTES	

ADMINISTRATION (A)

School or school system, general (AS)

Legislation	ASLE	(local, state, national)
Finance	ASFI	
School plant	ASSP	(including installations)
Public relations	ASPR	
Accreditation	ASAC	
Research activities	ASRA	(accomodated & carried on in schools & colleges)

Classification and Code		Remarks
Teaching and Administrative Personnel (AT)		
Recruitment, selection	ATRE	(including job opportunities)
Evaluation	ATEV	
Staff utilization	ATSU	(team teaching, teaching load)
Salary, benefits, contracts	ATSB	
In-service training	ATIT	
Certification, qualification	ATCQ	(legal aspects)
Use of non-certified specialists	ATNC	
Use of clerical aides	ATCA	
Pupil Personnel (AP)		
Entrance requirements	APER	(age, academic standards)
Enrollment	APEN	(includes number of graduates)
Desegregation	APDS	
Evaluation	APEV	(grades, promotion, failure, testing)
Dropout, continuance	APDO	
Guidance, counselling	APGC	
Job placement & counselling	APPL	(includes job opportunities and success)
Medical & psychiatric service	APMP	(includes psychotherapy)
Services, material	APSE	(lunch, transport, etc.)
Student finances	APFI	(scholarships, costs, etc.)
Discipline		
Administration in Relation to Environment (AE)		
Rural & small town	AERU	
Suburban	AESU	
City	AECI	
Lower class area	AELC	
Curriculum Administration & Development (AC)		
Adult education	ACAE	
Course requirements	ACCR	
Articulation & transfer	ACAT	
Special classes	ACSP	
Scheduling	ACSC	
Accomodation of ability range	ACAR	
Interdepartmental studies	ACID	
Evaluation & selection of audiovisual media	ACSM	
Extracurricular activities	ACEX	
Evaluation & selection of printed media	ACSB	

RESEARCH DESIGN (RD)*

Classification and Code		**Remarks**
Historical analysis	RDHA	
Theory development	RDTH	
Statistical survey	RDSU	(longitudinal or normative)
Comparative-foreign	RDCF	
Experiment	RDEX	
Case study	RDCS	
Report	RDRE	(no experiment)
Bibliography	RDBB	(included catalogues)
Book review	RDBR	
Development or evaluation of test	RDET	
Development or evaluation of audiovisual media	RDEM	
Evaluation of statistical method	RDES	
Development or evaluation of printed media	RDEP	

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*Review literature is assigned the code which describes the nature of the studies being reviewed; for example, a review of several experiments would be assigned the heading RDEX. In the same way, proposals or progress reports of uncompleted studies are assigned coded headings according to the type of study proposed or in progress.

Notes on the Assignment of Coded Notation

. Codes are to be listed in the right-hand column of the abstract form, one to a line, all in relation to one role-indicator, "KSH." The coded entries will be separated from the rest of the abstract at the "sentence" level, i.e. by the □... punctuation.

Example: A study of students in a parochial high school biology class, in which the effectiveness of a series of sound film is measured and correlated with intelligence as a variable.

□...KSH, PLCO (meaning) - church-operated school
PLSH - senior high
PPHI - high intelligence
PPLO - low intelligence
MMSO - sound film
TSSB - biological science

The "Research Design" facet will not be used on the telegraphic abstract, since the KAB phrase serves the same function. The RD facet is included in the classification schedule in order to be available to anyone who might want to use the schedule alone.

There are no technical limits to the number of codes which may be assigned. As a rule, however, most documents can be classified effectively with four to eight coded heads.

None of the subfacets or the members of subfacets are mutually exclusive. Any two or more members of a class may be found complementary for a given document, and are therefore combinable. Certain combinations are superfluous, however, and should be avoided for that reason. For example, where those items under "Instructional locale" (PL) which indicate school level are used, age-level headings under PA are usually unnecessary.

Furthermore, if it is found that more than three members of a

Notes

single subfacet are appropriate subheadings, it is usually better to assign the two-letter subfacet heading alone (followed by two dashes) rather than several members. For example, if several aspects of teacher personnel practice are given equal emphasis in a document, the assigned code should be "AT--."

Some subfacet headings are meaningless, however, when assigned alone. Subfacet headings to avoid using alone are:

Age Characteristics	(PA)
Instructional Locale	(PL)
Non-Student	(PN)
Administration: Environment	(AE)
Research Design	(RD)

There is no one facet that must be represented in all assignments (except for the RD facet, which is required for all documents when the classification schedule is used alone, without telegraphic abstract). It is rather rare for all four (five) facets to be represented in a single assignment.

Probably the most difficult decisions which must be made in assignment will be those which involve discrimination between two approaches to the same subject. When assigning subfacets, one should keep in mind the generic facet, as indicative of the point of view from which the topic is studied.

Consider, for example, a comparison of interpersonal relations among primary grade children observed in arithmetic and reading classes under homogeneous vs. heterogeneous grouping. Such a study would be assigned the codes for primary grade (PLSP), interpersonal

Notes

relations (PEIR), and ability grouping (TCAG), but not the reading and arithmetic codes under the teaching facet (TSRD, TSAM), because the teaching methods as such are not significant.

Another example might be a study of effects of variable teaching methods in special remedial classes for the hard-of-hearing in the intermediate grades. Appropriate codes would be PLSI (intermediate grade), PPHS (sensory handicap), TSRC (remedial methods) and PLSC (special class as locale), but not ASCP (administration, special classes), because the special classes are observed from the methods point of view, not from the administration point of view. For a further example, consider a report describing a course in script-writing for commercial television; TSCM (teaching of communication skills) would be a correct code, but not MTMM (commercial TV as a subject of study or significant teaching-method variable).

APPENDIX E

PART 2

SAMPLE TELEGRAPHIC ABSTRACTS AND CLASSIFIED CONVENTIONAL ABSTRACTS

Do not write in this space

T-0719

Col. 6-8	Role Indicator (Col. 28-80)	Col. 6-8	Description (Col. 9-27)
1	..KEJ,	2	CHILD
3	.KWV,	4	EMOTIONALY
5		6	DISTURBED
7	.KIS,	8	ELEMENTARY SCHOOL
9	..KEW,	10	PARENT (FAMILY)
11	..KAM,	12	DIAGNOSING
13	.KAM,	14	SCREENING
15	.KQJ,	16	PSYCHOLOGIST
17	.KAH,	18	PARENTAL
19		20	PERMISSION
21	.KAH,	22	REFERRAL
23	..KAM	24	CASEWORKING
25	.KQJ,	26	SOCIAL WORKER
27	..KAM,	28	EDUCATION
29	.KIS,	30	SPECIAL
31		32	CLASS
33	..KAB,	34	RESEARCH
35		36	IN PROGRESS
37	.KQJ,	38	JUDGE BAKER GC
39		40	NEW ENGLAND PHCC
41	KIS,	42	NEWTON MASS
43	..KUP KAP,	44	REHABILITATION
45	.KAL,	46	SPECIAL
47		48	THERAPEUTIC
49		50	CLASS

Abstracter BJC

301

Do not write in this space

T-0738

Col. 6-8	Role Indicator (Col. 28-80)	Col. 6-8	Description (Col. 9-27)
1	..KAB,	2	RESEARCH
3	.KIS,	4	INDIANA U
5	KEJ,	6	VISUAL
7		8	AID
9	.KIS,	10	INDUSTRIAL ARTS
11	.KIS,	12	MUNCIE IND
13	..KEW,	14	TEACHER (22)
15	..KAM,	16	INVESTIGATING
17	.KQJ,	18	QUESTIONNAIRE
19	..KUP,	20	NUMBER
21	.KUP,	22	TYPE
23	.KUP,	24	UTILIZATION
25	.KUP,	26	AVAILABILITY
27		28	
29		30	
31		32	
33		34	
35		36	
37		38	
39		40	
41		42	
43		44	
45		46	
47		48	
49		50	

Abstracter MGR

Do not write in this space

T-0739

Col. 6-8	Role Indicator (Col. 28-80)	Col. 6-8	Description (Col. 9-27)
1	..KEJ,	2	PUPIL
3	..KWV,	4	IQ
5		6	HIGH
7		8	AVERAGE
9	.KIS,	10	ELEMENTARY SCHOOL (6 + 7)
11		12	INTERMEDIATE
13	..KAM,	14	INSTRUCTION
15	.KQJ,	16	TELEVISION
17	.KEC,	18	BIOLOGY
19	.KEC,	20	MATHEMATICS
21	..KAM,	22	TESTING
23	.KQJ,	24	ACHIEVEMENT
25		26	TEST
27	..KAM,	28	STATISTICAL
29		30	ANALYSIS
31	.KAM,	32	
33	..KAB,	34	RESEARCH
35	.KIS,	36	CINCINNATI, OHIO
37	.KIT,	38	1959
39	..KUP KAP,	40	BIOLOGY
41		42	LEARNING
43	.KAL,	44	TEST
45	.KXL,	46	TV
47	.KXL	48	INTELLIGENCE
49	..KUP KAP,	50	MATHEMATICS

Abstracter BJC

Col. 6-8	Role Indicator (Col. 28-80)	Col. 6-8	Description (Col. 9-27)
51		52	LEARNING
53	.KAL.	54	ABILITY
55	.KAL.	56	TV
57	.KXL.	58	INSERVICE
59		60	EXPERIENCE
61		62	TEACHER
63		64	
65		66	
67		68	
69		70	
71		72	
73		74	
75		76	
77		78	
79		80	
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95		96	
97		98	
99		100	

Do not write in this space

T-0763

Col. 6-8.	Role Indicator (Col. 28-80)	Col. 6-8	Description (Col. 9-27)
1	..KEJ,	2	UNDERACHIEVER
3	.KIS,	4	OAKLAND CALIFORNIA
5	.KIS,	6	HIGH SCHOOL
7	..KAM,	8	INSTRUCTION
9	.KQJ,	10	READING
11		12	WORKSHOP
13	.KIS,	14	SECONDARY SCHOOL
15	.KAM,	16	TESTING
17	.KQJ,	18	STANFORD AT
19		20	ARITHMETIC
21	..KAB,	22	REPORT
23	..KEC,	24	DEVELOPMENTAL
25		26	READING
27	.KIS,	28	HIGH SCHOOL
29	.KEC,	30	ARITHMETIC
31		32	REMEDIAL
33		34	
35		36	
37		38	
39		40	
41		42	
43		44	
45		46	
47		48	
49		50	

Abstracter ______________

Do not write in this space

T-0946

Col. 6-8	Role Indicator (Col. 28-80)	Col. 6-8	Description (Col. 9-27)
1	..KUP,	2	INTELLECTUAL
3		4	PERSONALITY
5		6	CHANGE
7	..KEJ,	8	STUDENT
9	.KIS,	10	COLLEGE
11	..KAM,	12	MEASURING
13	.KQJ,	14	COOPERATIVE SCAT (COOPERATIVE SCHOOL AND COLLEGE ABILITY TEST)
15	.KQJ,	16	PERSONAL
17		18	JUDGEMENT
19		20	SCALE
21	.KAB,	22	DISSERTATION
23		24	SURVEY
25	.KIS,	26	U OF TEXAS
27	.KIT,	28	1961
29	..KEJ,	30	STUDENT
31	.KIS,	32	COLLEGE
33		34	ART
35		36	SCIENCE
37		38	EDUCATION
39		40	BUSINESS
41		42	ADMINISTRATION
43	.KIS,	44	U OF TEXAS
45	..KAM,	46	TESTING (1955)
47	.KQJ,	48	COOPERATIVE SCAT
49	.KQJ,	50	PERSONAL

Abstracter RBK

T-0946 (cont.)

Col. 6-8	Role Indicator (Col. 28-80)	Col. 6-8	Description (Col. 9-27)
51		52	JUDGEMENT
53		54	SCALE
55	.KAM,	56	RETESTING (1959)
57	..KUP KAP,	58	COLLEGE
59		60	PERSEVERANCE
61	.KAL,	62	SCHOLASTIC
63		64	ABILITY
65		66	INITIAL
67		68	
69		70	
71		72	
73		74	
75		76	
77		78	
79		80	
81		82	
83		84	
85		86	
87		88	
89		90	
91		92	
93		94	
95		96	
97		98	
99		100	

T-0719. Classes for Emotionally Disturbed Children. Edward Landy, et al. Research Relating to Children, Bulletin no. 13, Clearinghouse for Research in Child Life, U.S. Department of Health, Education, and Welfare, August 1960-January 1961, p. 61.

Pilot project to assess value of therapeutically oriented classes in rehabilitating emotionally disturbed children, involving two groups of children, seven to twelve years old, from Newton, Massachusetts public schools. Screening and diagnosis by school psychologists. Procedure includes social casework with the family and psychiatric work with the child.

RDEX	Experiment
PEMA	Emotional Maladjustment
PLSP	Primary Grade
PLSI	Intermediate Grade
APMP	Psychiatric Service

T-0738. Visual Aids and Their Use in the Muncie and Delaware County Industrial Education Programs, Richard M. Simon. Bloomington, Indiana University, August 1960, Abstract in AV Communication Review, March-April 1961, p. 160.

38 questionnaires sent to industrial education teachers in Muncie, Indiana. Study of 22 returns finds that individual demonstrations, motion pictures, models, and field trips far exceed all other forms of visual aids in their availability and use.

RDSU Statistical Survey
PLSJ Junior High
PLSH Senior High
TSIA Industrial and Applied Arts
MM -- Motion Pictures
MD -- Direct Experience

T-0739. Report of Three Experiments in the Use of Television in Instruction. L. Twyford. AV Communications Review, Vol. 8, no. 2, March, 1960, p. 71.

Sixth and seventh grade pupils of above average intelligence are instructed by television and conventional method in biology and mathematics. Achievement tests and statistical analysis indicate that effectiveness depends on subject matter.

RDEX Experiment
MT -- TV
PLSI Intermediate Grade
TSAM Mathematics
TSSB Biological Sciences

T-0763. Oakland, California. Jean A. Wilson and Jesse K. Peckenham. *Educational Research Service Circular* no. 2, National Education Association, May, 1961.

Programs for the underachiever, including a reading workshop at the junior and senior high level in addition to the regular English class, developmental reading for college-bound students who wish to improve reading efficiency, and remedial arithmetic at the ninth and twelfth grade levels.

RDRE	Report
PLSJ	Junior High
PLSH	Senior High
PEAC	Underachiever
TCRC	Remedial Teaching
TSRD	Reading
TSAM	Arithmetic

T-0946. Intellectual and Personality Changes in College Students as Measured by the Cooperative College Ability Test and the Personal Judgment Scale. Vincent Casimir Waiches, University of Texas, Dissertation Abstracts, June 1961.

Study of changes in academic ability and self-structure of 100 male and female college students (University of Texas) during four years. Testing by Cooperative School and College Ability Test and personal judgment test upon entrance and at the time of graduation. Data supports the proposition that students who persevere in college tend to be those who initially have more scholastic ability.

RDSU Statistical Survey
PLUG Undergraduate College
PI -- Ability as variable
PESC Self Concept

APPENDIX F

GLOSSARY

OF

INFORMATION RETRIEVAL TERMINOLOGY

as used at

Center for Documentation and Communication Research

Western Reserve University

ABSTRACT

(1) A precis or summary. See also CONVENTIONAL ABSTRACT.

(2) A TELEGRAPHIC ABSTRACT.

ABSTRACTER

One who makes the CONVENTIONAL ABSTRACT and/or the TELEGRAPHIC ABSTRACT.

AUTOMATIC ENCODING

The machine process by means of which each term keypunched from the TELEGRAPHIC ABSTRACT is matched against the CODE DICTIONARY (1) and is assigned its SEMANTIC CODE. Upon completion of this process, the separate Hollerith cards for terms and ROLE INDICATORS are reassembled and made ready for card-to-tape CONVERSION.

BARRIER

The logical division between sections, or syntactical LEVELS in a TELEGRAPHIC ABSTRACT. Barriers are indicated by the system of PUNCTUATION illustrated following the entry for LEVEL. Searching between barriers is thus possible in the WRU system.

BI-WEEKLY

One schedule for CURRENT AWARENESS searches.

BOOLEAN ALGEBRA

"The science of symbols denoting logical propositions and their combination according to certain rules which correspond to the laws of logic." - Webster's New International Dictionary, Third Edition.

In the WRU system, as generally in documentation, the expression "Boolean Algebra" is used to designate a system of notation which is useful to express relationships of conjunction, disjunction, etc. In addition to paired brackets indicating relationships, as:

( )

[ ]

{ }

the Boolean notation includes devices to show the "and" concept (·), the "or" concept (+) and the "but not" concept (-). Thus,

$$\left\{\left[(A + B) \cdot (C + D)\right] \quad (E + F)\right\}$$

can be read as "Either A or B together with either C or D (i.e., AC, AD, BC or BD) must appear along with either E or F." The Boolean polynomial above will be satisfied with any of the following combinations:

ACE
ACF
ADE
ADF
BCE
BCF
BDE
BDF

CDCR

Center for Documentation and Communication Research, School of Library Science, Western Reserve University.

CODE, n.

(1) The SEMANTIC CODE as a system.

(2) The combination of SEMANTIC FACTORS, INFIXES, and END NUMBER which expresses an individual term in the SEMANTIC CODE.

CODE, v.

(1) To construct a SEMANTIC CODE for a term.

(2) To process a group of terms appearing in a TELEGRAPHIC ABSTRACT, by means of AUTOMATIC ENCODING.

CODE DICTIONARY

(1) The file of Hollerith cards for terms which have been assigned SEMANTIC CODES.

(2) A listing made from the cards described in (1) above, used for reference by the CODING and QUESTION ANALYSIS staff. See also REVERSE CODE DICTIONARY.

CODE-TO-WORD DICTIONARY

See REVERSE CODE DICTIONARY

COMPILING

A COMPUTER routine designed to check the SEARCH STRUCTURE. An "illegal" symbol, for example, or an unpaired bracket (an unclosed parenthesis) is revealed by compiling. This routine prevents the expense of time and money on a SEARCH for the answer to a question that is mechanically unsearchable. (Compiling can only check the formal expression of a question, of course; a search structure can pass the test and still reflect an inelegant process of QUESTION ANALYSIS. Such an event will be indicated by the results of the search.)

COMPUTER

See GE 225.

CONJUNCTIVE RELATIONSHIP

The so-called *logical product*, i.e., the required appearance within a single specified context (a document or part of a document) of (at least) two specified items. This relationship is represented in BOOLEAN notation as A·B, that is, A *and* B.

The *logical difference* (A-B, that is, A *without* B), may be included here.

CONVENTIONAL ABSTRACT

A summary paragraph, or precis, in conventional English, of the significant concepts of a document. It includes the terms listed in the TELEGRAPHIC ABSTRACT or, if these are too numerous or too detailed, it summarizes them. The conventional abstract also includes complete bibliographical data for the original document. Its first purpose is to indicate to the questioner the reason that a document has been selected as a response of interest. In some of the CDCR projects, it serves a second purpose as material for a continuously published abstract bulletin.

CONVERT, v.

To transfer the information from the TELEGRAPHIC ABSTRACT, properly keypunched and AUTOMATICALLY ENCODED, from Hollerith cards to magnetic tape. The conversion is done by a card-to-tape PROGRAM, using the card-reader of the GE 225.

CURRENT AWARENESS

Information on material which has been published or made available recently. In the WRU system, current awareness searches are made on a BI-WEEKLY basis. A continuing current awareness subscription entitles the questioner to a search every two weeks of all documents added to the file in the previous two-week period.

DESCRIPTOR

A simple descriptive word or phrase, used to characterize a document. An index entry.

DISJUNCTIVE RELATIONSHIP

The so-called logical sum, i.e., the required appearance within a single specified context (a document or part of a document) of either of two or more specified items. This relationship is represented in BOOLEAN notation as A+B, that is, A or B.

EDITOR

The staff member of the CDCR who checks the CONVENTIONAL ABSTRACT and the TELEGRAPHIC ABSTRACT for accuracy and formal consistency. In addition, he is constantly evaluating the retrieval value of the terms in the abstract.

EVALUATE

To examine the product of a SEARCH (3), the document numbers furnished by the computer in response to the SEARCH STRATEGY, in order to determine whether the individual documents are RELEVANT, PERIPHERAL, etc.; to label them appropriately and (in the CDCR routine) to forward them to the questioner.

FACET

A major aspect of a subject; the whole aspect represented by many related concepts. In the classification scheme developed for the Pilot Project, the major facets are Population, Media, Teaching, Administration, and Research Design.

FACTOR

See SEMANTIC FACTOR.

GE 225

A high speed, general purpose computer. The installation at Western Reserve University has a core memory capacity of 8,000 words with two magnetic tape handlers. It is equipped with 400 card-per-minute card reader, a 100 card-per-minute punch output, and a typewriter.

KEY WORD IN CONTEXT (KWIC)

A display prepared by machine manipulation of punch cards representing titles of documents, each "key word" of which is permuted, or rotated, until it takes first place in a single alphabetical array. Any one title, in a KWIC "index," thus appears as many times as it contains "key words" to be permuted.

LEVEL

Any of the several sections into which the analysis of a document is divided.* Each section is indicated by the PUNCTUATION and organization of the TELEGRAPHIC ABSTRACT. Levels are utlized in the logic of QUESTION ANALYSIS. They are specified in the SEARCH STRUCTURE by various typographical designations. See the chart below.

PUNCTUATION	"GRAMMATICAL" ANALOG	UNIT**	LEVEL
		Semantic factor + numerical infix	0
	Syllable	Semantic factor + numerical suffix	1
,	Word	Semantic factor (for one term)	2
.		Role Indicator + coded term/s	4
..	Phrase	Related Role Indicators + coded term/s	5
▱...	Sentence	Related Phrases	6
/	Paragraph (Abstract)	End of Abstract	8

* Cf. Ranganathan's use of level to designate any of plural "manifestations" of a fundamental category.

** The "unit" relationships are somewhat simplified in this presentation. For a more detailed discussion, see J. W. Perry and Allen Kent, eds., Tools for Machine Literature Searching (New York and London: 1958), and the several Manuals for Abstracters prepared at the CDCR for the various projects. See also Appendix C, Part 2.

NON-PERTINENT

Of no interest to the questioner.

PERIPHERAL

Of possible though not guaranteed interest to the questioner: said of a response judged to be probably relevant. In the course of a continuing (BI-WEEKLY) search, peripheral responses are often included in the package sent to the questioner, with a form-sheet requesting his evaluation of each. The questioner's vote (continue to send/do not send) helps to guide a revision of QUESTION ANALYSIS and SEARCH STRUCTURE.

PERTINENT

See RELEVANCE.

PROGRAM, n.

(1) A set of instructions, prepared by skilled technicians, for the performance of a routine by a COMPUTER.

(2) Loosely, the SEARCH STRUCTURE prepared as the product of QUESTION ANALYSIS. In this sense, program often designates the BOOLEAN polynomial by which the file (on magnetic tape) is addressed.

PROGRAM, v.

(1) To specify, in complete detail, the instructions which will guide a COMPUTER in the performance of a routine.

(2) Loosely, to prepare a SEARCH STRUCTURE.

PUNCTUATION

The system of typographical designations by which BARRIERS are established between LEVELS in a TELEGRAPHIC ABSTRACT. For a list of punctuation devices, see LEVEL. For examples in use, see TELEGRAPHIC ABSTRACT.

QUESTION ANALYSIS

The process of

(1) determining the exact nature of a request received in any of the several projects at the CDCR;

(2) contacting the questioner, if necessary, in order to clarify an ambiguous or vague phrasing of the question;

(3) consulting appropriate authority, either printed or professional; to give further insight into the nature of the request;

(4) compiling, by the use of the CODE DICTIONARY and the REVERSE CODE DICTIONARY, an exhaustive list of the significant SEMANTIC CODES for the formulation of a SEARCH;

(5) specifying by means of ROLE INDICATORS the context in which significant concepts may predictably be expressed in the TELEGRAPHIC ABSTRACTS in the file;

(6) expressing the SEARCH STRUCTURE, with SEMANTIC CODES, ROLE INDICATORS, and LEVELS all specified, in the form of a BOOLEAN polynomial.

RELEVANCE, RELEVANCY

"The state or quality of being relevant; pertinence." Relevant "implies close logical relationship with, and importance to, the matter under consideration (relevant testimony); ... pertinent implies an immediate and direct bearing on the matter in hand (a pertinent suggestion)." - Webster's New World Dictionary of the American Language, College Edition. As this synonymy suggests, the words are loosely applied in general use. In CDCR practice, a working distinction is made between a relevant response, which might be called a direct hit, and a pertinent response, which is closely connected to the answer to a question and which is presumed to be of interest to the questioner. A clearer distinction separates both relevant and pertinent responses, on the one hand, from PERIPHERAL or NON-PERTINENT responses, on the other.

RETROSPECTIVE

Information on material which has been published or made available during the period for which files have been maintained, or for any discrete part of this period. A retrospective search may be specified for all of 1960, for example.

REVERSE CODE DICTIONARY

A listing of all the encoded terms in the CODE DICTIONARY (1), accomplished by a PROGRAM designed to arrange the CODES in alphabetical sequence by code. This arrangement displays the THESAURAL relationships of the coded terms, by grouping together those codes which share the same SEMANTIC FACTORS.

ROLE INDICATOR

One of a schedule of codes, usually alphabetical symbols, used to designate the part, or role, played by each term selected as an indexable feature of a document. Examples:

KEJ	Material processed
KAM	Process
KUP	Property determined

In a TELEGRAPHIC ABSTRACT, the role indicators together establish a context which can be predicted in QUESTION ANALYSIS and specified in SEARCH STRATEGY. For example:

(1) student as KEJ, Subject of study, rather than as KAL, Influencing factor.

(2) TV as KAL, Influencing factor, rather than KQJ, Means by which a process is carried out.

SEARCH, n.

(1) The act of examining the file in order to retrieve RELEVANT information.

(2) See SEARCH STRATEGY; SEARCH STRUCTURE.

(3) In the Computer Laboratory, the employment of technical skills to utilize the GE 225 in the various routines necessary to test the validity of the question (see COMPILING) and to run the properly structured question against the CODED file of TELEGRAPHIC ABSTRACTS on magnetic tape. The product of the search, in the usual routine, is an automatically punched Hollerith card bearing the designation of a document accession number, along with the number of the search for which that document number represents a response.

SEARCH STRATEGY

The skill exercised in QUESTION ANALYSIS and the formulation of a SEARCH STRUCTURE.

SEARCH STRUCTURE

The structuring of the search follows the procedure of QUESTION ANALYSIS. Loosely known as the PROGRAM, the search structure represents:

(1) the terms which the Question Analyst expects to find in the CODED TELEGRAPHIC ABSTRACTS on tape, and

(2) the relationship between those terms, as specified by ROLE INDICATORS and PUNCTUATION.

The Question Analyst expresses this structure by means of a BOOLEAN polynomial, substituting appropriate SEMANTIC CODES for the A's and B's of the formula.

Thus,

$$\left\{\left[\text{N-BT 1046} \cdot (\text{N-LL 1004} + \text{PAPL})\right] \cdot \text{S-CH}\right\}$$

would represent the search structure for a combination of "retarded" and either "mental" or "person," along with "school."*

---

* This is actually a working structure for the question "Learning processes and teaching methods for the mentally retarded." It was later sharpened and sophisticated by the inclusion of ROLE INDICATORS, omitted here for the sake of simplicity.

SEARCHING SELECTOR

The machine designed and built at the Center specifically to SEARCH files of TELEGRAPHIC ABSTRACTS. The storage medium was punched paper tape. The advantages of the Searching Selector were its comparative speed and accuracy, and (to a less significant degree) its dramatic patterns of audible clicks and flashing lights. In comparison, its successor in the WRU system, the GE 225, has the advantages of unchallenged accuracy, infinitely greater speed, and considerably improved versatility and compatibility with ancillary equipment.

SEMANTIC CODE

(1) The system of alphabetical and numerical symbols used for the AUTOMATIC ENCODING of the English terms on the TELEGRAPHIC ABSTRACT. "Artificial, polysynthetic, agglutinative, language."*

The purpose of the Semantic Code is:

(a) to regularize the form of the "language" stored on tape.

(b) to establish a THESAURUS-like relationship between similar concepts to aid in QUESTION ANALYSIS and the formulation of SEARCH STRATEGY.

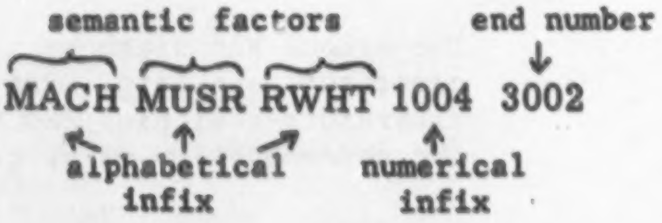
The Semantic Code consists of:

(a) Over 200 SEMANTIC FACTORS from which an appropriate selection is made for the original incoding of any English term.

(b) A schedule of ALPHABETICAL INFIXES, one of which is inserted between the first and second letters of each semantic factor.

(c) A serial list of NUMERICAL SUFFIXES, or END NUMBERS, one of which serves to individualize every separate code that is entered into the CODE DICTIONARY. When a one-factor code is incorporated into a multiple-factor code, its own end number accompanies it as a NUMERICAL INFIX. A new, unrelated end number is assigned to the multiple-factor code of which it forms a part.

Example:



(2) The combination of SEMANTIC FACTORS, INFIXES, and END NUMBER which expresses an individual term; same as CODE (2).

---

* John L. Melton, "The Semantic Code Today."

SEMANTIC FACTOR

One of a schedule of more than 200 three-letter combinations each of which represents a discrete concept* useful in the expression of the technological vocabulary.

C-MT	Direct communication; language	M-CH	Device
D-CM	Recorded information	M-MT	Emotion
D-CT	Direction	M-SR	Measurement
D-MN	Administration	P-LC	Policy, Plan
G-PR	General Property	P-PL	Human Being
		P-RD	Product, Effect

These may be used singly or combined in groups of two, three or four, with the "grammatical" interrelationships expressed by means of ALPHABETICAL INFIXES and the specific, individualizing NUMERICAL INFIXES where appropriate, and END NUMBERS. Examples:

MAMT 1017	Personality
CUMT 1109	Interviewing
CYMT 1109 PAPL 2349	Interviewee
DACM MYMT 1017 MUSR 3594	Schaie TBR

---

* Bliss used factor to mean "a digit in notation."

SPECIAL

One or more characters, either alphabetical or numerical or both, which do not correspond to the normal pattern of the SEMANTIC CODE. One example, of many, is the biological code for Corneal Aspergillosis:

BVPS X120 DASG 2260 MACR J630 3020

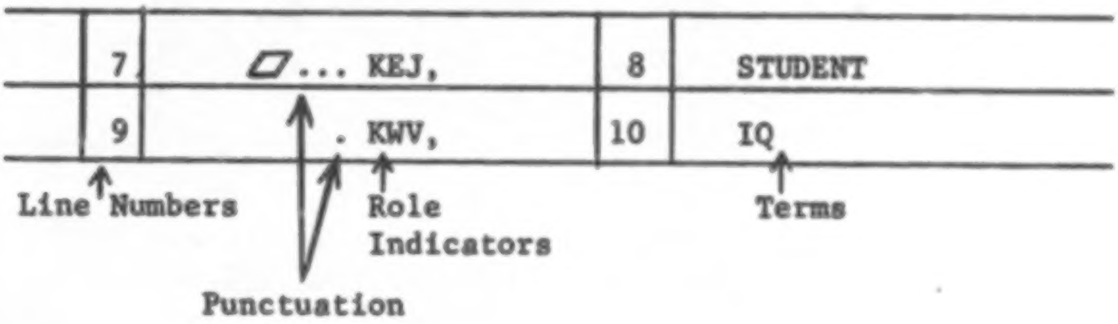
The second and sixth parts of this code, X120 and J630, constitute specials. Provision is made, in the regular literature-searching PROGRAM (1) of the COMPUTER, for the accommodation of specials.

SUBJECT HEADING

Any of a series of headings, or categories, together representing an overall view of a field of interest. The parent schedule of subject headings may be arranged either alphabetically or in a hierarchal array. In the latter case, the subject headings may be grouped in FACETS.

TELEGRAPHIC ABSTRACT

An analysis of a document consisting of a detailed list or index, of significant terms selected from the natural text. Priority in the metallurgy file is given to words naming materials, processes, and properties. Terms (listed in the right-hand column of the abstract form) are related to each other by means of ROLE INDICATORS (listed in left-hand column). BARRIERS between LEVELS are indicated by PUNCTUATION preceding each role indicator. The coded terms, together with the role indicators and associated punctuation, become a computer-searchable record on magnetic tape. (For specific application in the field of educational research, and for examples, see Appendix B, Part 2, and Appendix E, Part 2.)



THESAURUS

A collection of words, as of synonyms and antonyms, classified by "concept," i.e., comparatively broad clusters of meanings, rather than by alphabetical or other characteristics. In Information Retrieval, the term Thesaurus is often used to designate a schedule of authorized headings, "terms," "descriptors," etc., arranged so that like words are grouped together and appropriate "see" and "see also" references are specified.

In the WRU system, the REVERSE CODE DICTIONARY exhibits the thesaural relationships between words. Reference to the Reverse Code Dictionary during QUESTION ANALYSIS and the formulation of SEARCH STRATEGY avoids the problems of flexibility and currency encountered in the maintenance of a list of authorized subject headings, and at the same time avoids the pitfalls of using uncontrolled natural language.

UNITERM

A system of indexing, using single, significant words selected from a document and then seeking to retrieve information by specifying such single words either singly or, more often, in combination.

WRU

Western Reserve University, Cleveland 6, Ohio.